Editorial

EVERY credit belongs to the amateur transmitters of New South Wales for their fine efforts during the recent disastrous floods.

For days and nights on end, amateurs in all parts of the flooded area operated their radio stations, and at times somebody else's, sending vital messages to the listening world outside.

Sometimes first news of impending disaster was flashed by an amateur in a call for help. In many other cases, amateurs operated the only communication link available after complete destruction of normal channels.

Other amateurs in comparative safety worked with their fellows in the danger zone to handle the outward end of the message chain. The Wireless Institute's own station was manned continuously for days and nights on end, watching channels for emergency calls, and handling a seemingly endless stream of traffic of every possible description. Men gave up their work to man it.

National emergencies are always likely to happen. If they could be anticipated, they would not be emergencies. No matter how well communications are organised, unforeseen or unusually severe conditions will arise when every helper can save lives.

Amateurs are extremely valuable men in such cases. They are used to working under difficulties, of making do with unlikely equipment, of getting results with poor material. Many of them can claim to be experts in this art. Others are qualified engineers, used to equipment of commercial quality.

It's not every field in which we have enthusiastic men prepared to finance their own activities and training and capable of rendering such unique and willing service. We should do everything possible to encourage them and to add to their numbers.

The PMG could help by granting the issue of novice, probationary licences to young fellows keen to make the grade. Our Government can encourage the country's representatives at the next international conference to urge a sympathetic case against slicing away amateur frequencies as has been done in the past.

We can all help by appreciating the fact that amateurs are not just radio cranks, fiddlers with valves, or men who sit up half the night playing with radio.

By their record they have shown themselves a valuable national asset in time of need.

John Moyle

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RADIO
TELEVISION & HOBBIES

A NATIONAL MAGAZINE OF RADIO, TELEVISION, HOBBIES AND POPULAR SCIENCE

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OUR COVER PICTURE

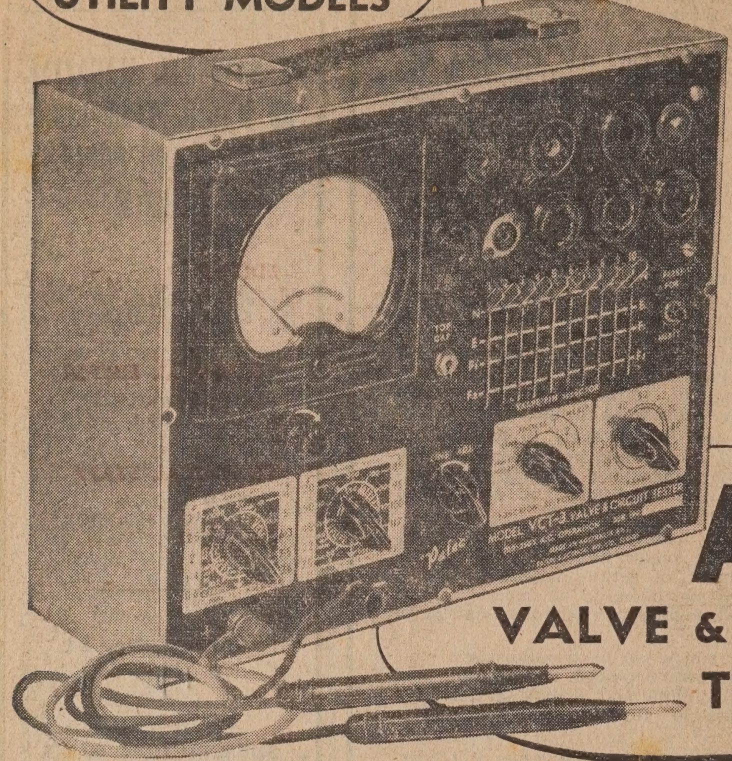
Rockets and guided missiles are first priority in the defence plans of all countries at the present time. In Switzerland work is being done in the Alps with this mobile launching device.

2 New Palec UTILITY MODELS

ET4 VALVE TESTER, and VCT/3 VALVE & CIRCUIT TESTER

featuring

- Greater flexibility
- Faster action
- Insurance against obsolescence
- Economical prices



Palec VALVE & CIRCUIT TESTER

Both the ET4 and the VCT/3 embody a completely flexible system of element selection designed to facilitate the testing of the very extensive and ever increasing range of receiving valves.

This system incorporates 10 SELF CLEANING LEVER ACTION SWITCHES, which permit the elements to be switched individually by levers numbered in accordance with the R.M.A. code, so that any particular pin or element can be readily identified.

Valves with tapped filaments or double supported elements can be tested, as any pin can be switched to neutral and out of the circuit.

OTHER FEATURES

Room on panel for future socket types. New valve data forwarded regularly if requested. No adaptors required. Attractive 5 inch square meter.

***IN ADDITION** the VCT/3 has the following Multimeter ranges:*

VOLTS D.C.: 0/0.1-3-10-30-100-300-1000 } 1000 ohms per
VOLTS A.C.: 0/3-10-30-100-300-1000 } volt all ranges.
CURRENT D.C.: 0/1-3-10-30-100-300 Milliamperes, 0/1-10 Amperes
CURRENT A.C.: 0/1M.A. (For use with ext. current transformer.)
OHMS: 0/1000, 0/10,000, 0/1 Megohm—(Self contained batteries).
DECIBELS: Ref. level 1 M.W. in 600 ohms—10/+10, +10/+30, +30/+50.
Ref. level 6 M.W. in 600 ohms —7/+3, +13/+23, +33/+43.

PRICES:

VCT/3 Valve and Circuit Tester, as illustrated	£46/15/-
ET4 Valve Tester	£37/-/-
Heavy Duty Plastic Carry-cover available	£1/19/6

NOTE: VCT/3 is supplementary to but does not supersede Model VCT/2, 10,000 O.P.V. which is still available, Price £58/15/-.

All prices are plus Sales Tax, and are subject to alteration.

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Manufacturers of all Types of Radio & Electrical Test Equipment & Meters
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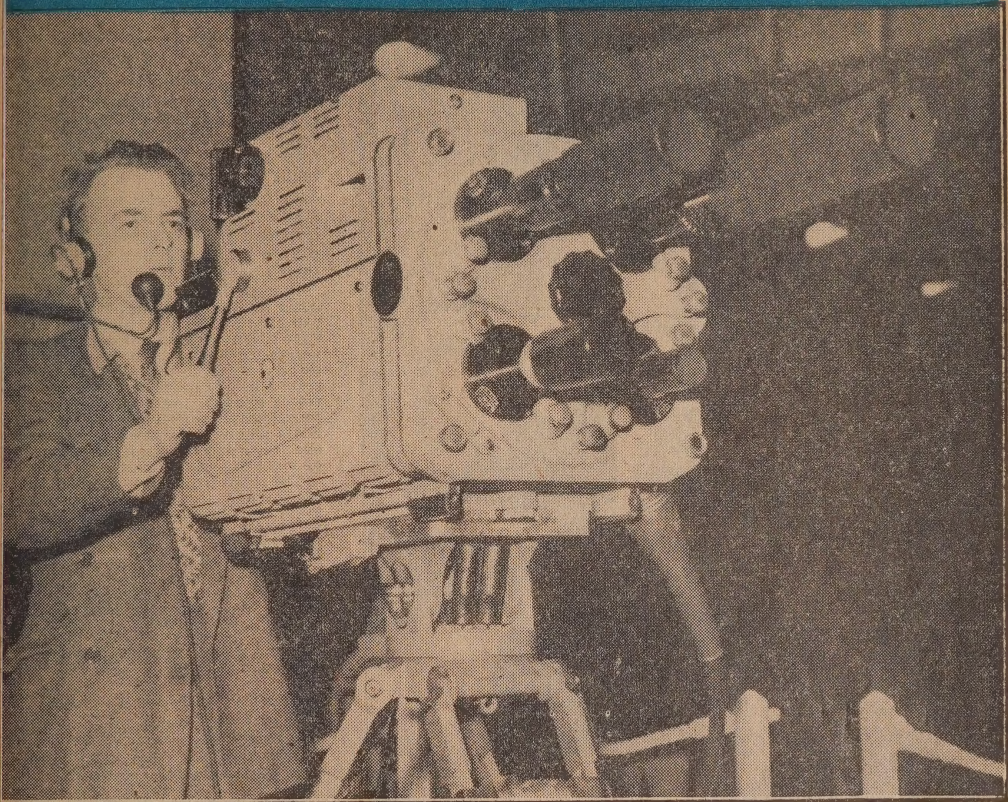
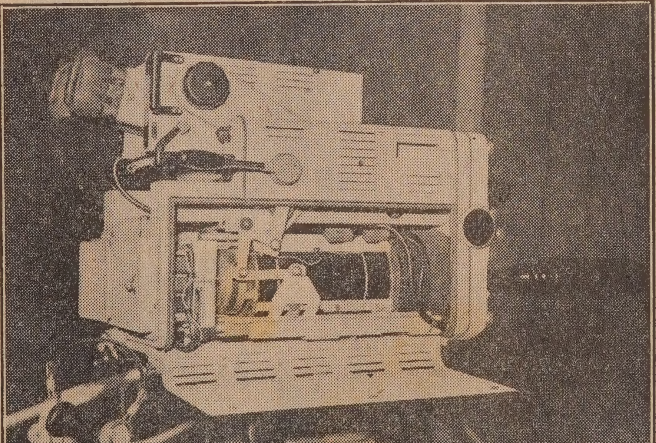
BRITISH "PERFECT" TV CAMERA



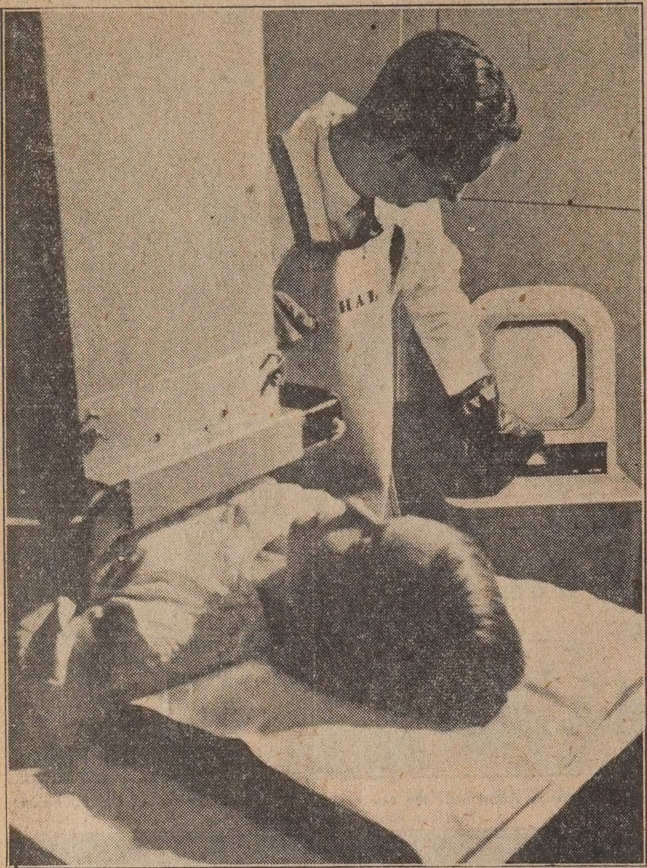
Engineer Terence Barret tests the new camera before the opening of the exhibition. The four lenses give great flexibility.

AT England's recent Television Society exhibition, the latest developments in TV included this new camera, just off the secret list. It gives the "perfect picture" and has been under BBC test for some time. Made by Marconi and costing £2000 it can look into bright light without producing black picture outlines. It is built around a new 4½in Orthican tube which is 1½in larger than those used at present. It weighs 160lb and has 4 lenses. The Orthicon, which is the heart of the camera, costs £800.



A close-up of the camera showing the 4½ inch Orthicon tube.

THE WIZARDRY OF ELECTRONICS



MEDICINE is fashioning itsel a bright new world through scientists, engineers, and physicists, who are studying the applications of electronic methods. Already electronic training is a necessary part of medical equipment for modern practice in the art of diagnosis and healing. The stethoscope, the physicians' standby since 1815, is rapidly being replaced by marvellous, push-button instruments.

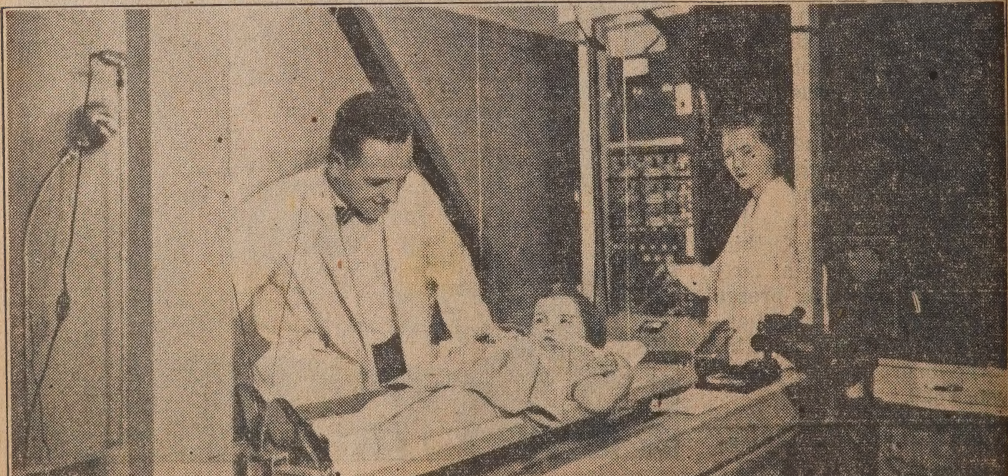
It is probably in the field of diagnosis that progress has become most rapid. Nearly all electronic tools have been pressed into service. The x-ray machine has been augmented by the fluoroscope and TV tube to record in picture form what the electronic eye can see. Oscilloscopes are found everywhere recording heart beats and pulse shapes, brain waves are recorded through the medium of electronic amplifiers.

The high cost and complexity of many such instruments has thrown great weight on the importance of well-equipped hospitals where such facilities can be installed and operated by specially trained technicians and medical men.

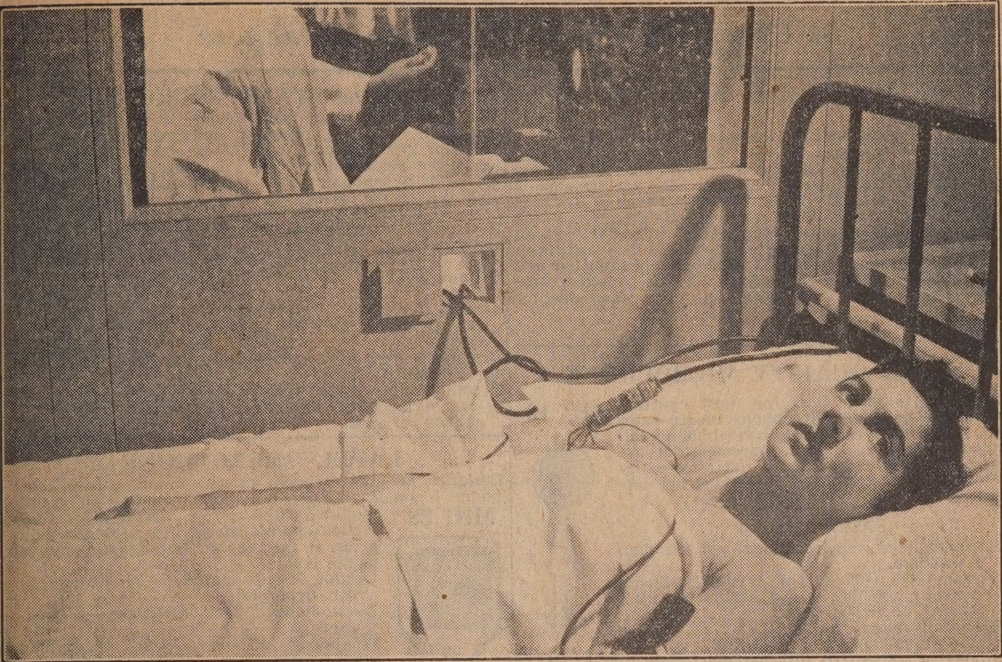
These pictures were taken in the famed Johns Hopkins Medical Institute in Baltimore, and illustrate some of the varied phases of medicine in which electronics has been intensively applied.

Left—The TV flouroscope couples a TV camera and a standard flouroscope. It electronically intensifies the image 1,000 to 100,000 times without harmful increase in x-ray exposure.

Below — Each time the heart pumps there is an almost imperceptible backward thrust similar to a rifle recoil. Measurement with the ballistocardiograph can detect early heart disease.



BUILDS A NEW MEDICAL WORLD



A 3-D view of heart action is promised by the vectorcardiograph which gives a three-dimensional information about the patient displayed on a TV-like screen.

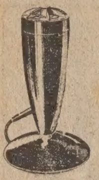
Electronics, combined with pure tones, detects deafness in youngsters and measures exact levels of hearing loss through conditioned reflex reaction to electric stimulation.

"ACOS" CRYSTAL MICROPHONES and MICROPHONE INSERTS

A Complete Range For Every Purpose

DESK or HAND MICROPHONE

MIC 36



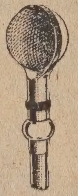
Housed in attractive plastic case, this Microphone is ideal for home recording and public address, etc. Response unexcelled for its size and price. The performance is not affected by vibration, shock or low frequency wind noise. Omni- directional frequency response substantially flat from 30 to 7000 c.p.s. Recommended load resistance not less tnan 1 megohm dependent on low frequency response. Can be supplied complete with switch and floor stand adaptor as required at a small extra cost.

£6/18/6

HIGH QUALITY MICROPHONE

MIC 16

Designed to meet even the most exacting requirements, this Microphone incorporates the world famous floating crystal sound cell construction. Its special characteristics are that its fine performance is not affected by vibration or shock. The fidelity is not impaired by low frequency noise.



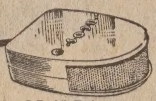
SPECIFICATION

Recommended load resistance—not less than 1 megohm.
Output level −65 db ref. 1 volt/dyne/cm².
Frequency response—substantially flat from 30 c.p.s. to 10,000 c.p.s.
Directivity—non-directional.
Size—2-1/8in spherical diameter.
Connector—Standard international 3-pin.

£24/19/6

GENERAL PURPOSE

MIC 35



£2/15/-

The MIC 35, undoubtedly the best value ever offered, is ideal for amateur transmitters, public address, etc. Housed in an attractive die-cast case, it features a high sensitivity and substantially flat characteristics. Provided with a built-in shunt resistance of 2 megohms, it will, when connected to the grid of the input valve, give a substantially flat response from 50 to 5000 c.p.s.

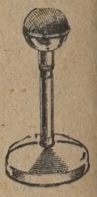
SPECIFICATION

Output level: −55 db ref. 1 volt/dyne/cm².
Cable—approx. 4ft. of co-axial supplied.
Weight—6ozs. unpacked, 7 ozs. packed.
Dimensions—microphone only 2¼in x 2⅛in x ⅞in.

TABLE or STAND MICROPHONE

MIC 22

This omni-directional Microphone is robust in construction, with a pleasing appearance. Vibration, shock or low frequency wind noise will not affect the performance. The low frequency cut-off is dependent on the load resistance. The cut-off is given by the quotation, F = 80 divided by R, where F = c.p.s., R = megohms. An adaptor (floor mounting) is available at low extra cost.



SPECIFICATION

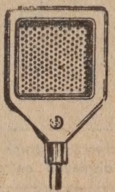
Output level = −50 db ref. 1 volt/dyne/cm².
Output impedance—equivalent to approximately 0.002 uF (0.8 megohm at 100 cycles).
Frequency response—substantially flat from 40 to 6000 c.p.s.
Recommended load resistance—not less than 1 megohm, dependent on low frequency response.

£9/18/6

LAPEL MICROPHONE

Designed to give freedom of movement, this Microphone is small and non-directional. Housed in a soft moulded rubber case, which gives protection against shock, it is provided with a pin at the rear of the case for pinning to the lapel.

MIC 28



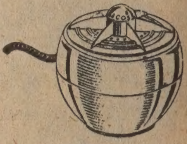
£5/19/6

Output level—approx. −55 db ref, 1 volt/dyne/cm².
Recommended load resistance—5 megohms.
Frequency response—level throughout the whole of the audible spectrum.
Capacity—0.0015 uF. at 1000 c.p.s.
Impedance—100,000 ohms at 1000 c.p.s.
Cord—6ft. shielded cable.
Size—1-9/16in wide x 2¼in long x 5/8in thick.

HAND or DESK MICROPHONE

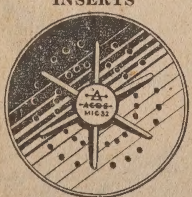
MIC 33

This Microphone has been designed for the high quality public address and home recording field. High sensitivity and flat characteristics are obtained by a specially designed acoustic filter. Housed in an attractive plastic case with an unexcelled response for its size and price. Unaffected by vibration, shock or low frequency wind noise. Omni-directional frequency response substantially flat from 30 to 7000 c.p.s.



£6/18/6

MICROPHONE INSERTS



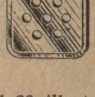
(MIC 32 illustrated)

CRYSTAL MICROPHONE INSERTS

These inserts are available in varying sizes ranging from as small as 15/16in square to 1-13/16in round, with various thicknesses from 7/32in to 9/16in. Suitable for every purpose such as hearing aids, public address, tape recording, amateur broadcasting, etc., they have responses from 2250 c.p.s. to 3500 c.p.s. at 5 db to 30 db. Insert can be supplied with or without 10 meg. resistor as required.

MIC 32 insert, **£2/15/6**; all others, **£1/19/6**.

MICROPHONE INSERTS



(MIC 23 illustrated)

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UNDERSEA CABLES MAY CARRY TV

Once regarded as a fantastic dream, international undersea cables carrying television programs are now acknowledged as technically feasible. Communications engineers say that, given sufficient incentive and finance, the technical problems associated with such a venture would not long remain unsolved.

AT the moment, neither incentive nor finance is sufficient to prooke any action, because the contruction of a lengthy undersea cable nk is a venture which requires normous financial backing and full nternational co-operation between he nations concerned.

It is completely beyond the reources of any single organisation.

Thus, while present-day program irectors may often dream of an nter-continental relay, they have o accept the idea as impractical for he time being.

But the position must inevitably hange as the world becomes more nd more television - conscious, and he need grows for a greater variety f program sources.

NEW CABLE

The current optimism of commuications engineers is based on the xperience they have gained in deigning and preparing for a new elephony cable which is shortly to e laid across the Atlantic.

When it sinks to the bottom of he ocean during the Atlantic summer, it will represent an investment worth about £12,500,000, and a sub-ocean link more than ten times longer and far deeper than any other in existence.

The 36 channels it will carry will depend for their success and continuity on the behavior of 312 valves and all their associated components, operating miles beneath the surface of the Atlantic.

Every forty miles along the cable, a submerged "repeater" amplifier will boost the signal on its way, keeping it ahead of the losses and noise which would otherwise render it inaudible.

If the techniques prove successful—and the best British and American brains are backing the scheme —then they may well be applicable to a new cable with a sufficiently wide pass-band characteristic to accommodate a television channel.

TRANSISTORS

The new cable, however, would not use valves. Instead, it would employ carefully developed transistors capable of providing the necessary gain along the cable, with wide bandpass characteristics and a minimum of power supply problems.

At the moment, most transatlantic traffic is carried by radiotelephone links, one of them no less than 27 years old.

This original long-wave circuit between Rugby and Rocky Point is currently supplemented by a shortwave system, providing 16 channels in all—but not nearly sufficient for today's pressing needs.

On the surface, the logical step would seemingly be to extend these radiotelephone facilities rather than spend such a colossal sum on a type of cable link as yet unproven.

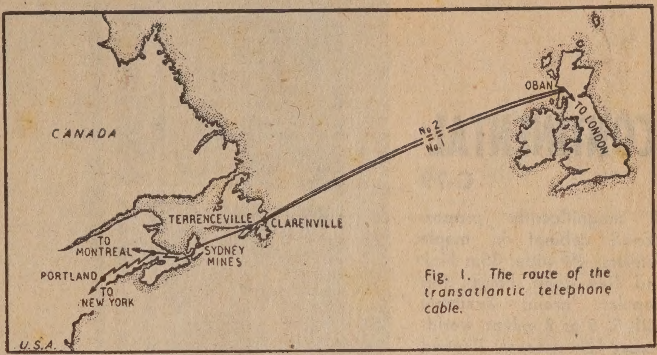


Fig. 1. *The route of the transatlantic telephone cable.*

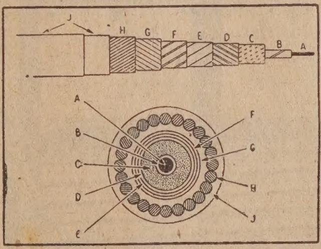
There is good reason for the step, however. No additional channels are immediately available for extending the radiotelephone service, and even those currently in use are frequently interrupted by interference and ionospheric conditions. Furthermore, the distances involved are too great for VHF links as are used for overland work.

Hence the determination to go ahead with the cable project.

THE PROBLEM

The real difficulty about a cable is in signal attenuation along the line. Such attenuation is serious, even in cross-country open-wire lines, but it is far more so in a submarine cable, where a solid dielectric has to be used with its much higher rate of attenuation.

Because of the inductance and capacitance present, the attenuation rate increases steeply with frequency and the first Atlantic cable laid down had a frequency limit of about one cycle per second! It could, therefore, be used only for very slow telegraphy.



Cross-sectional and constructional views of the deep-water type of coaxial cable A. Centre conductor. 0.1318in dia copper. B. Three 0.0145in copper surround tapes. C. Polythene to 0.620in diameter. D. Six 0.016in copper return tapes. E. 0.003in overlapped copper anti-worm tape. F. Gapped Telcomax tape. G. One serving of cutched jute. H. Twenty-four .086in diameter high-tensile steel armor wires. J. Two impregnated-jute servings.

By employing the latest techniques and materials, this rather ludicrous limit could conceivably be raised to about 100 cps, but this is still quite inadequate for even a single voice channel.

Means must obviously be used to make good the losses, particularly with raising frequency.

On land, the problem is overcome by having "repeater" stations at intervals along the cable, which correct frequency errors and also raise the level of the signal, keeping it at all times above the threshold of noise.

Allowing an attenuation rate of 1db per mile for an ordinary underground cable, a 20-mile run reduces the signal power by nearly 99 pc, which can be made good by an amplifier at the receiving end.

PROHIBITIVE LOSS

However, the power losse over a 200-mile run of the same line would be such that the noise problem alone would prevent the signal being reconstituted by any known amplifier system.

It is obvious, therefore, that a Transatlantic telephone cable must depend for its success on a chain of repeater amplifiers distributed along its length and no more than about 40 miles apart.

The idea of a series of floating repeater stations, moored in mid-Atlantic, was examined but abandoned as impracticable. The only alternative was to have submerged repeaters spliced into the cable and capable of operating for years on end without maintenance.

Such a project obviously raises many questions. Can the necessary number of electronic circuits be relied upon to function without break-

BIG VALUE IN AUTOMATIC RADIOGRAMS

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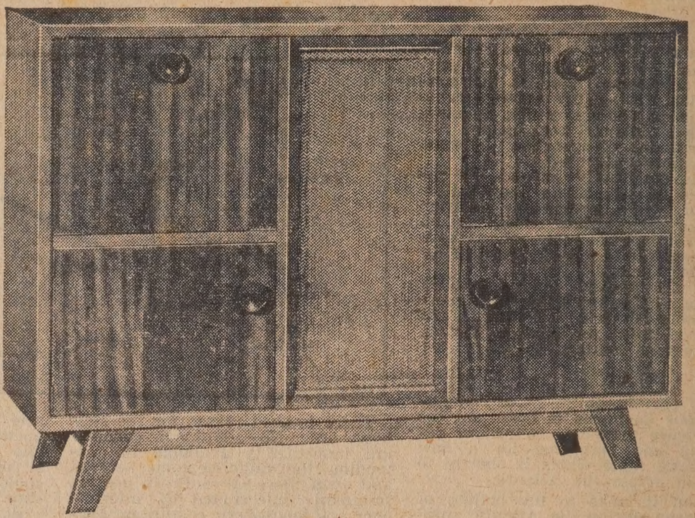


CONTINENTAL

C-79

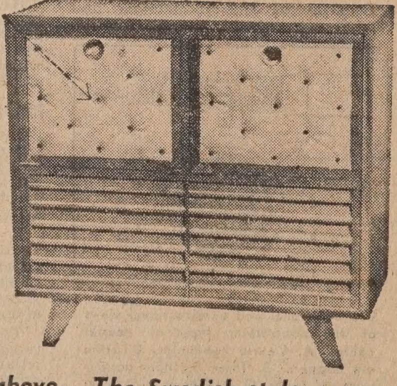
A magnificently proportioned cabinet in maple veneers, 4ft wide, 35in high and 18in deep, houses this popular 'gram, available with 5, 6 or 8 valves, world-range; 12in speaker; 3 speed record changer. Expanded aluminium grille, with record or glassware storage space on either side increases its appeal.

Models illustrated are latest contemporary styles. Ask also to see the very attractive range of conventional Calstan models.

Calstan

CALibrated to STANdard

RADIOS AND RADIOGRAMS



—another popular Calstan model is the NEW YORKER also available with 5, 6 or 8 valves and other technical features as the Continental, above. The Swedish-style, maple veneer cabinet has studded plastic panels in the very latest trend of today.

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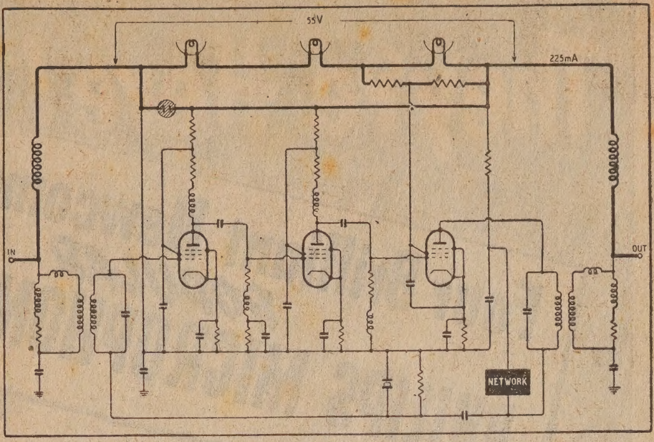
SEE THEM AT ALL GOOD RADIO RETAILERS

CIRCUIT OF THE REPEATER AMPLIFIER



Amplifier circuit diagram of the American-type repeater. The power circuit is distinguished by heavy line and for clarity the heaters are shown separately above the valves to which they belong. (Diagrams by courtesy of Wireless World.)

wn for so long? If such a break-wn should occur, how can it pos-ly be localised without taking up e whole cable?

How can the valves be powered d how can the repeaters be lower- into position without risk of dam-e or cable fracture?

The wrong answer to any one of ese questions — and many others— uld spell failure to a 12½-million und venture.

In point of fact, the British Post ffice has been accumulating know-dge and experience over the years hich has proved very valuable to gineers planning the new Atlantic ble.

The first submerged repeater ation was laid in 1943, in a cable etween Anglsey and the Isle of Ian. Since then another 30 odd epeaters have been put into service round the British Isles, with ex-ellent results.

TEST" CABLE

Most of these repeaters lie in elatively shallow water but one 16-epeater cable between Scotland and candinavia was designed deliber-tely with the Atlantic project in ind.

Meanwhile the Americans have lso been working on the project ough, for geographical reasons, ith less practical incentive than ritish Post Office Engineers. Two ables, each including five repeaters, ere laid by US engineers between avana and Key West and these ave been operating without incident ince 1950.

Under a contract between the Brit-sh Post Office and American Tele-hone companies, two cables will ow be laid, following a similar oute across the Atlantic. They will e arranged to carry traffic in oppos-te directions, a shorter common hannel between Clarenville and ydney Mines carrying signals in oth directions, as well as local raffic. (See map.)

The whole deepwater section of ach cable will be laid in a single ength — about 1500 miles — and eighing about 5000 tons. The only hip in the world equal to the task s HMTS Monarch, which is cheduled to lay the first cable dur-ng 12 days in the coming Atlantic ummer.

ARRIER TELEPHONY

The second cable will be laid in he corresponding period of the ollowing year.

In conformity with modern prac-ice, the new cables will use the arrier telephone principle, by which o less than 36 single sideband chan-els will be fed through the line, ach 3 Kc wide. Thus, the cable will e called upon to handle frequencies p to 164Kc, as compared with 100 dd cycles which would have been easible without the use of wide-and repeater stations.

Over the shorter section between larenville and Sydney Mines, larger nd more elaborate sunken repeaters ill be used, accommodating 60 or ore channels and involving trans-ission frequencies up to 552Kc!

This represents half a megacycle n bandwith and, given sufficient unds and experience, engineers can ee no fundamental reason why the igures of distance and bandwidth hould not ultimately be multiplied o make possible the transmission of ideo signals.

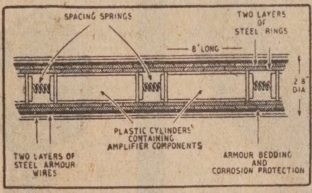
The new cable is of massive construction, capable of withstanding the enormous stresses of laying and operating at depths up to 2½ miles.

The central conductor is slightly thicker than 10 gauge copper, overwound with copper tape.

Over this is the main dielectric — a layer of British originated polythene.

The outer conductor is made up of six copper tapes, overwound with a further worm-resisting copper tape. Then comes the Telcomax magnetic screening, steel armor wiring and jute outer covering.

Additional armor is provided where the cable approaches the shore and where local abrasion is possible.


SPACING SPRINGS
TWO LAYERS OF STEEL RINGS
8' LONG
2.8" DIA
PLASTIC CYLINDERS CONTAINING AMPLIFIER COMPONENTS
TWO LAYERS OF STEEL ARMOUR WIRES
ARMOUR BEDDING AND CORROSION PROTECTION

Longitudinal section showing construction of American-type flexible repeater built into the main trans-atlantic run of the cable.

Experience in laying cables has indicated that a very great difficulty exists when a bulky repeater station has to be lowered over the side along with the cable. The ship has to be hove to while the repeater is spliced in, after which the whole assembly has to be lowered over the side and on to the ocean bed without placing undue strains upon the cable itself.

The danger of kinking the cable is an ever-present one.

With this problem in mind, American engineers decided to design their repeaters so that they would fit inside a long flexible tube, which could be wound up along with the cable on the storage drum, then pass out smoothly through the cable-laying guides.

To design and produce a repeater amplifier in such a restricted space, safe against the ingress of moisture or actual collapse under a pressure of 3 tone per square inch, to have a gain of 23db at 12Kc and 65db at 108Kc, to maintain these figures within close limits for 20 odd years and be fed from the shore was no mean specification to meet.

The completed amplifier, which meets these requirements, is a flexible bulge in the cable, 8 feet long and 2.8in diameter, tapering down to normal cable diameter within a distance of 20 feet.

MUST BE STRONG

Inside the bulge are 15 seperate plastic cylinders, each containing a group of components and strung together with flexible springs, like a string of sausages. These are protected by overlapping steel cylinders, which are overwrapped in turn by copper, steel armor and jute.

The tensile strength of the cable, which must be sufficient to support several miles of its own length sloping away to the ocean floor, had to be maintained across the repeater sections.

Electrically, the American type repeater is a 3-stage amplifier, using pentodes which are old enough to have been on continuous test for 13 years. Designed for long life, they have only a moderate figure of transconductance and a heater rated to draw 0.25 amp at 20 volts.

The amplifier contains several interesting features.

The heaters are connected in series to produce a voltage drop of 60 volts between input and output. This is sufficient to supply the plates and screens, so that no separate high tension supply is called for.

Performance of the amplifier is held constant by a feedback network, designed to counter any natural drift in the characteristics. This feedback is also compensated suffi-

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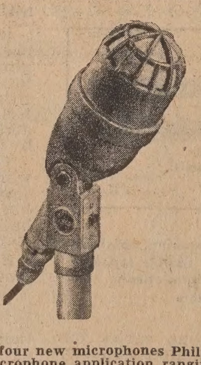
A hyper-cardioid moving coil microphone. This unidirectional, very sensitive, high quality microphone enables the gain of the amplifier to be increased considerably without risk of acoustic feed-back! Reproduction of ambient noise is so weak that for the same effect the normal speaking distance can be doubled. Tropic, rain and dust-proofed.

★ *Only the world-wide Philips organisation could produce such outstanding Quality at such a low price!*

TYPE No. EL 6040

The most outstanding microphone in the entire range! The "pencil" microphone has a frequency response which is substantially flat from 50 to 15,000 CPS. The exceptional combination of optimum reproductive quality and great mechanical strength opens up quite new possibilities in the public address field . . . broadcasting . . . television . . . and film recordings.

★ *Robust construction Eye-pleasing design.*



TYPE No. EL 6020

Non - directional electro dynamic microphone admirably suitable for high quality sound recording as well as broadcasting use. Due to special design, it is exceptionally efficient where group recordings are being made.

★ *Superior craftsmanship in design and precision finish is evident in every component of these new Philips Microphones.*

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A moderately priced extremely robust microphone for general purpose work where reproduction of both speech and music are required. Can be employed just as efficiently in the open air as in enclosed spaces. Equipped with durable plastic diaphragm . . . tropic-proofed. Output impedances: at 10,000 ohms, 2.4 mV. 500 ohms, 6 mV, 200 ohms, 4mV.

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ciently to provide the required frequency law between input and output.

Also in the feedback network is a crystal, one in each amplifier, and each tuned to a different frequency between 167 and 174Kc.

Presence of this crystal causes a peak in the response which is largely equal to the natural gain of the amplifier. By feeding appropriate signals though the cable and listening to them on the remote shore, it is possible to gauge the natural gain of each amplifier, and the noise level at the resonant frequency.

Any departure from normal is readily apparent.

Should an amplifier fail in service, its peak is missing and reference to a chart will reveal which amplifier has failed and just where along the cable it is located.

It might be supposed that failure of a heater would render the whole cable inoperative, and, therefore, the whole testing procedure. In actual fact, this is not so.

HEATER FAILURE

A gaseous discharge tube is shunted across each heater chain and, in the event of such failure, the sudden rise in drop across the chain fires the tube and re-establishes continuity of the line.

Absence of the response peak, as already described, indicates which of the amplifiers is at fault.

Added to the 55 or 60 volts drop across each amplifier unit—of which there are 52 in all—there is an additional drop of 20 volts across each 40-mile section of the cable. From end to end of the cable, there is, therefore, a total drop of 4000 volts.

To minimise voltage stress, half this voltage is fed in at each end, in opposite polarity. Thus, no part of the cable differs from sea potential by more than 2000 volts.

To minimise risk of failure in service, a great deal of care has been taken with the manufacture of the amplifier units. All components are specially selected and assembly is done by trained workers in air-conditioned rooms.

Whereas American designed repeaters are to be used in the main deepwater cables, British repeaters will be used in the Nova Scotia to Newfoundland section.

These are larger than the American units, being non-flexible cylinders, 9ft long and 10½in in diameter.

DUPLICATE AMPLIFIERS

They contain duplicate amplifiers in the interests of reliability, each capable of passing a much wider band of frequencies. There are amplifiers for East-West and West-East traffic, so that the one cable is capable of carrying all traffic on the twin Atlantic cables, with several channels to spare.

The amplifiers use modern high-Gm valves with platinum cathode cores to combat poisoning effects in service. As in the American units, crystals are used to facilitate testing of individual amplifiers, but the test frequencies are much higher, being in the 260-264 Kc band.

A special frequency multiplier in each amplifier modifies the basic frequency and brings it into the band of frequencies used by the return channel. Thus it is possible to test the amplifiers from one end of the cable, the signal being injected at one frequency and returning to the same point at the appropriate multiple.

Mechanically, the repeaters are hydrogen filled, sealed at both ends and spliced into the cable during the laying process. Though they will naturally not coil on to the drums, an ingenious modification of the laying mechanism allows them to be fed through it without discontinuity in handling.

CLOSER SPACING

Because of their wider pass-band, the British repeaters are laid at more regular intervals, actually one every 20 miles.

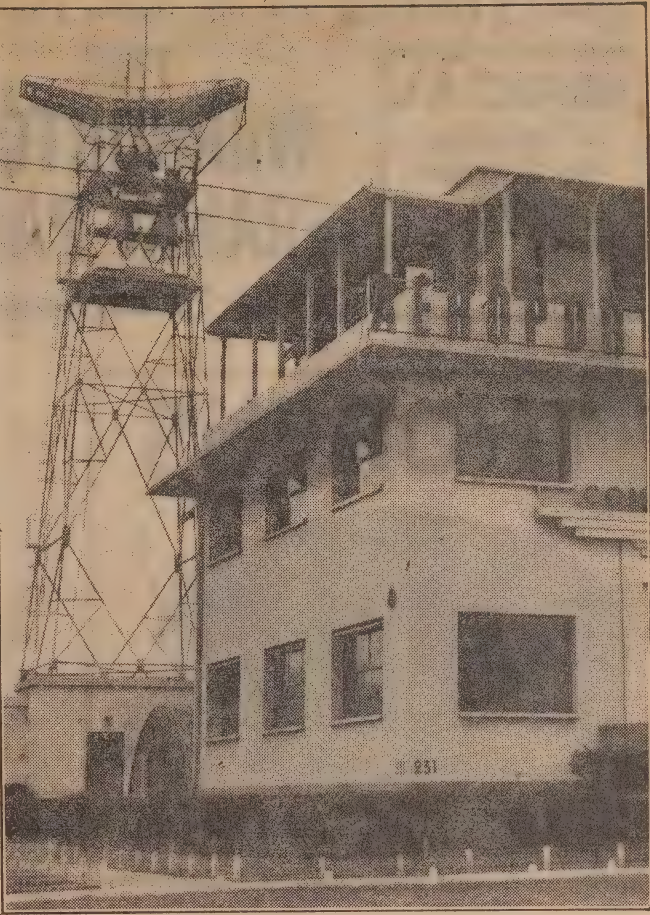
At present, the total number of repeaters which can be installed in any one length of cable is largely limited by the supply voltage which can safely be applied to the ends of the cable. This situation, in turn, makes it necessary to achieve a certain minimum gain in each repeater and prevents them being designed for a wider pass band than has been achieved.

The use of transistors in place of valves would allow a radical increase in the number of stages which could be supplied for a given voltage, thereby permitting more amplifiers to be used, each designed for a much wider frequency response.

As the new cables go into service, communications engineers will watch their behavior with intense interest. But already they are looking forward to the day when cables can be laid carrying transistorised amplifiers in barely noticeable bulges along their length; when such cables will carry a multitude of channels and, perhaps, even that enticing video signal.

Truly, a far cry from the original 1 cycle per second.

NEW FRENCH AIRCRAFT RADAR



A new radar set has been installed at the French aerodrome at Orly claimed to be the most powerful yet used. This picture shows its novel aerial installation on a pylon attached to the control tower.

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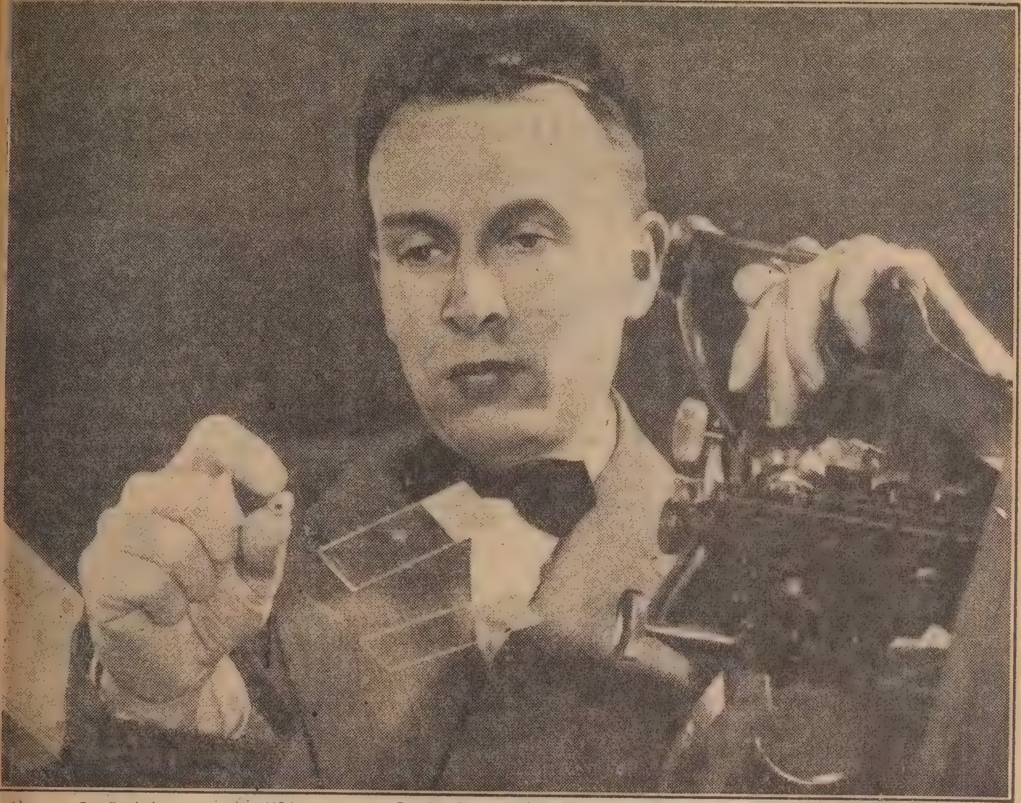
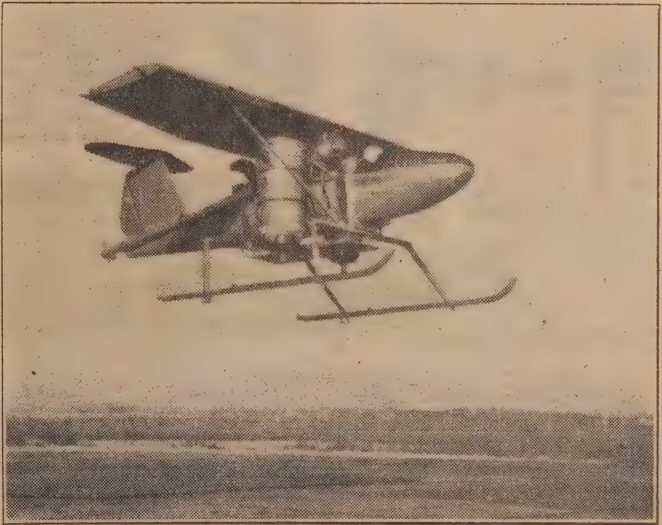


Dr. H. Tracy Hall holds a capsule containing a laboratory-made diamond.

Above — G. E. Laboratories in USA have announced success in making artifical diamonds from carbonaceous material subjected to intense heat and pressure generated in laboratory equipment. The research team says its success crowns 125 years of effort to duplicate nature's most glamorous gem. So far no practical outcome application of the process has been announced.

☆

Right — Interest continues to centre around the problem of making an aircraft which can take off vertically and fly horizontally at high speeds. The Bell Aircraft Corporation is experimenting with a version which uses twin jets, mounted at the side of the fuselage. For take-off they point downward, and move into a horizontal position for level flight. Picture shows the aircraft on a test flight at Niagara Falls, N.Y.



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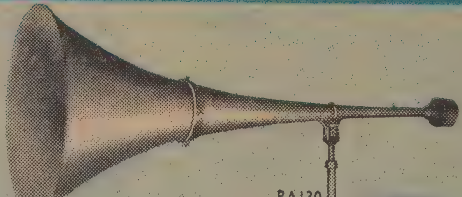
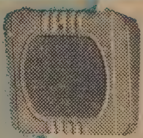


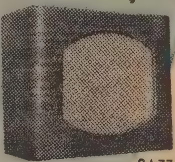
PA130

Standard exponential horn speaker for public address where distance projection of speech and incidental music is required.



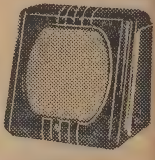
PA150/I

Attractive moulded ivory cabinet with 7" cone speaker and 600 ohm line transformer. Suitable for wall or desk mounting



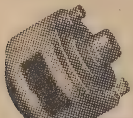
PA77/12PS

Polished timber cabinet for wall or table mounting with 12" cone speaker and 600 ohm line transformer.



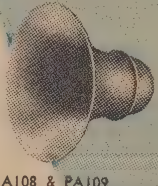
PA150/W

Moulded walnut speaker, similar to above. These models are also available with 600 ohm stepped faders.



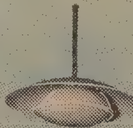
RESLO DRIVE UNITS: SU10 & SU12

Exclusive features are the self-locating diaphragm and the concentrically interlocked magnet which together produce an undisplaceable mechanical assembly, proof against decentering.



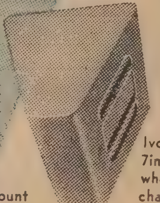
PA108 & PA109

These flare baffles are for use with 7in and 12in permanent magnet cone speaker units and provide high conversion efficiency.



PA118

Pendant type, ceiling suspension, 360° diffusion speaker suitable for distribution of voice and music.

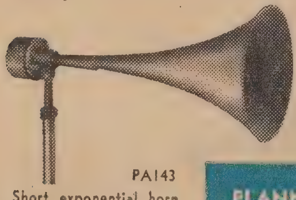


PA73

Ivory timber cabinet with 7in speaker for applications where a bi-directional characteristic is desired.

PA177

Flush, ceiling mount 360° diffusion reproducer with 7" cone speaker. Can be colour matched to suit any background.



PA143

Short exponential horn speaker for distance projection of speech only.

PA178

Surface mount reproducer similar to PA177, for use where flush fitting is not practicable.

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CURRENT CLOSE-UP OF SCIENCE

The heart of the Hale telescope is a 200-inch glass mirror, with a huge curved surface. This 15-ton mirror is suspended in a huge steel cradle that weighs 500 tons. Yet the mechanism is so finely balanced that the instrument can be rotated by a one-twelfth horse-power motor.

Into Space

THE real purpose of this super-telescope is to enable astronomers to penetrate as far as possible into the depths of the cosmos. And there is so much to be studied in the outer regions of the universe that telescope time is at a premium on Mount Palomar.

But astronomers are only human. They have used some of the precious time to have a look at the planets that keep us company as we make our way around and around the sun. Using the Hale Telescope in this way is like using the Queen Elizabeth as a cross-channel steamer.

The Planets

JUPITER, Venus and Mars, are the most photogenic of the nine planets. Little Mercury, sweltering at a distance of only 36-million miles from the sun, is so close to the sun that it is rarely visible from earth. When it does appear it is low on the horizon during the half-lght of dawn or twilight.

Uranus, Neptune and Pluto, on the other hand, are so far away that they appear as pin-points. But Venus, Mars and Jupiter are near enough to the earth to show us something of their intriguing personalities when seen through the Hale Telescope.

Jupiter, mammoth

JUPITER is the Mammoth Planet with the Cyclops eye. At its equator, Jupiter has a diameter 11 times that of the earth, and the mass of the planet is more than 300 times that of the earth. Jupiter takes nearly 12 years to make its journey around the sun on an orbit which is 483-million miles away from the sun.

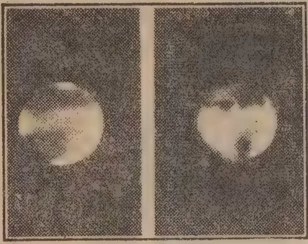
Photographs show that around the centre of Jupiter there are dark belts that change their shape and position from time to time. Above them is the Great Red Spot of Jupiter which was first observed in 1878.

This huge "eye" seems to float slowly about in the atmosphere, changing its color slowly between red and grey; it disappears at intervals but always comes back. The origin of Jupiter's eye is as much a mystery as are the dark patches on Mars.

The small bright spot which is often seen is one of Jupiter's 12 satellites, the one called Ganymede which Galileo discovered. It is small only in comparison with Jupiter. It is actually bigger than Mars.

Venus, not dry

VENUS is almost the same size as the earth and is only slightly less heavy. Venus has a plain, almost unmarked surface. It is believed to be covered by a dense atmosphere, and until recently astronomers were unable to detect any water vapor or oxygen.



Two pictures of Mars taken (left) with blue filter which shows up clouds and haze and (right) red filter which makes visible some surface features.

Jupiter's atmosphere is mostly hydrogen and helium, not the best for space travel.

Temperature measurements made recently with the help of the Hale Telescope have shown, however, that there is a cold cloud layer at about —38 deg. Fahrenheit. The atmosphere above this is too cold to hold water vapor, which accounts for the previous observations that Venus was "dry".

These clouds of water vapor imply that there is liquid water on the surface of Venus. But if this is so, it must cover the whole surface. So anyone landing on Venus will probably have to swim for it.

Mystery of Mars

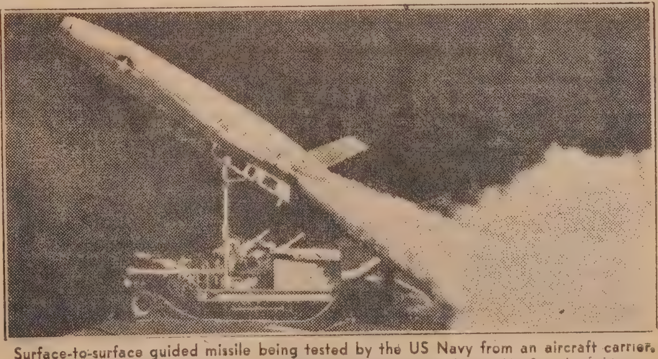
BLUE-LIGHT photographs show the bright polar caps of the planet Mars. These glistening white regions are known to consist of ice, probably in the form of a thin layer on the surface of the planet. They extend their areas in winter and recede in summer.

Much of the surface of Mars, shown in the red-light photographs, is covered by deserts. These are the light areas which cover about three-quarters of the planet's surface. The dark areas, covering about a fifth of the planet, have been a mystery for hundreds of years. The overall shapes of the dark areas remain well-defined, but the details change from year to year.

These dark areas may be some form of vegetation, changing with seasonal and climatic variations on the planet. They do not reflect infra-red rays in the way that our cholorphyll-containing higher plants do. But they behave in this respect like some Arctic lichens.

If there are Martians on Mars, they must be tough. The climate is severe, remaining at about 30-40 degrees below zero Fahrenheit on the average, although rising above freezing point in summer. Nights are intensely cold.

The thin atmosphere, at a pressure similar to that 11 miles above our earth, is mostly nitrogen and carbon dioxide. So the 200in telescope has merely confirmed what a lot of us feel—that there's a lot to be said for staying here on earth and away from Mars.



Surface-to-surface guided missile being tested by the US Navy from an aircraft carrier. Note portable launcher and JATO containers which drop off after launching.

The magnificent golden eagle soars thousands of feet in the air at great speeds up to 120 miles per hour.

ONLY THE STRONG CAN SURVIVE

In order that the fittest shall survive, nature has provided animals and birds with a variety of defensive measures against the depredations of their fellows.

THE same cannot be said about human beings. Almost every defensive measure that man possesses is something he has developed himself such as spears, arrows, poisons, guns, bombs, and, on a grander scale, warships, submarines and aeroplanes.

The natural defences of the human male species amount to no more than fists and boots. To the female of the species can be added fingernails to scratch with, teeth to bite with, a tongue to flay with and tears to cry with.

It is evident, therefore, that the female is much better equipped than the male to withstand the onslaughts of others.

NO PUNCHES PULLED

A male opposed to a male is something, but a male opposed to a female is in a hapless position. True, if a male were to cast chivalry aside and give an argumentative female a good old proverbial "belt behind the ear" things might be different. But when a female calls her most potent defence into action and starts to cry, he is just about beaten from the start.

It's good, though, isn't it? One gets such a wonderful feeling—apologising and telling lies about not meaning what he said!

In wild nature no punches are pulled, and it's every thing for itself. Even some species of trees and plants are provided with a means of defence.

There are plants with venomous thorns and enveloping tentacles.

There are plants which catch insects and digest them.

In the sea, where danger lurks unceasingly for almost every inhabitant, remarkable means have been provided for them to offer some measure of defence.

Why then has man been left defenceless? Is it because he has the intelligence to invent his own defences? Wild life, without such intelligence, must have the means of defence provided?

In the main, the most important measures provided by nature for defence are speed, concealment, acute eyesight, acute sense of smell, acute sense of hearing, protective armor and various kinds of warning devices.

CAMOUFLAGE

Concealment usually takes the form of special coloring which we refer to as camouflage. A particular coloration of the body may blend almost perfectly with the color of the surroundings.

A tiger's stripes, a leapord's spots, are examples of this camouflage and these animals are almost invisible to the eye in their natural surroundings.

Certain kinds of worms, caterpillars and butterflies are so colored as to resemble closely the earth, leaves or flowers in which they live. The praying mantis or stick insect is very hard to find in a tree, so closely does it resemble a stick of wood.

When it comes to speed we have some remarkable performances. For instance, there is an insect called the deer bot fly. This fellow is credited with a top flying speed of 800 odd miles per hour. He must have conquered the sound barrier long before man ever thought of it.

Only the male can fly this fast. Indeed, it is a fact that the male of all living creatures including man, is usually the fastest—at least in speed. The reasons are obvious, and as far as the human species is concerned, speed was the only way in which primitive man could catch himself a wife. Nowadays you catch 'em in other ways—with diamonds,

Extreme case of natural armor-plate is the armadillo, which has a hard outer shell to ward off its enemies.

cars, fur coats and so on. Even then they are pretty hard to keep up with, and you never know when you've got 'em.

The aforesaid deer bot fly always rises to fairly high altitudes when flying at high speeds.

The golden eagle can fly at a speed of 120 miles per hour and the duck hawk has been timed at 180 miles per hour.

Gazelles are very speedy animals, reaching a speed of 60 miles per hour.

It is noteworthy that animals cannot maintain these speeds for any considerable time. Just long enough to get clear of a pursuing enemy.

Speedy animals are specially built. As a rule, the lower leg bones are longer than the upper, and they have a very flexible spine.

Some birds and many animals are endowed with very keen eyesight. Wild geese and ducks and vultures have eyes that can see far beyond the range of human eyes. This enables them to see enemies from afar off or sight their food from considerable distances.

Coupled with keen eyesight is the capacity of some animals to send warning signals to its mates a long way off.

NATURE'S HELIOGRAPH

One species of antelope is provided with a rear end covered with a patch of white hairs. When an alarm is sounded this patch of hairs expands into a disc and by means of an opening and shutting movement it sends out signals something like the heliograph used in warfare. These signals can be sent even when the animal is running at high speed and that is something which no soldier can do with the man-made heliograph.

These "rump" signals can be seen for many miles with the keen eyes of the antelope's mate.

A kind of jack rabbit also uses a flashing signal. The white underparts extend up the sides while the dorsal area is dark in color. When alarmed, the white area is drawn up the sides and the dark area becomes only a thin line on the back. By expanding and contracting the muscles, a flashing effect is produced.

WARNING WHISTLE

There is a whistling marmot in America which can emit probably the most piercing sound in all nature. It is a whistle which can be heard up to a distance of two miles. Naturally every marmot in the area gets going when he hears this whistle and hides until the sentry gives the "all clear" signal which is a whistle of a much lower pitch.

Beavers warn their mates of impending danger by slapping their tails hard on the surface of the water. This can be heard for miles and after the alarm is given there is an acute scarcity of the animal for some time afterward.

Many animals are provided with heavy armor. In this respect the armadillos take the prize. Almost every part of the body is covered with horny plates even to the ears.

by Calvin Walters

These animals are aptly named, although I don't think the name means exactly what my interpretation says. They are covered in armor and they are "dilly"—armadillo. They are the most stupid animal alive.

The armadillo's eyesight is about non-existent and he is most restricted because of his armor. He hardly knows where he is or where he is going. He allows all and sundry to occupy his burrow and frequently harbors snakes, rabbits and other animals at the same time—a real lodging-house.

Jet propulsion was invented by the octopus long before man ever thought of it. This fish swims backward by ejecting a stream of water through a tube from a container in its body. He can move very fast this way but only backward. To move forward he uses his tentacles.

This fellow also sends out a smoke screen of a brownish-black fluid which dyes the water for many feet around at a sign of danger. Under cover of this he "beats it" very smartly. This is akin to the smoke screen sent out by planes and warships.

While we are on fish did you know that a fish which lives in the Caribbean Sea has eyes like bifocal glasses? Because he mostly lives on food floating on the surface, he has to see both under the water to see where he is going and on top of the water to see what's about in the way of eats.

His eyes, therefore, have two pupils, one to see above the water and the other to see in the water. He is thus well equipped to see danger either above and below.

A female crab in the Great Barrier Reef is so scared that she protects herself by sentencing herself to solitary confinement for life, although she hasn't done anything. She gets into a fork of coral and by some means sets up movement in the water which causes the coral to grow around her thus finally confining her in a small cage of coral. Small apertures let in the water carrying the food on which she lives and there she is for the rest of her life.

Nobody knows whether she means to do this or whether she is just too dumb to notice.

SEA HORSE

The Australian sea horse up in the waters above Australia has to be pretty smart, because he is so slow. He does pretty well, however, although he has no equipment to fight with. Instead, he has a wonderful tail that is so similar to the seaweed in which he lives that it is almost impossible to see

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im when he attaches himself by he tail to the said seaweed.

A peculiar reptile is the rattlenake found in America. He has what amounts to a thermostat in his head. It seems to be in the pit ocated between his nostrils and the ye. If the nostrils are plugged and he eyes covered, a rattlesnake will strike at an electric light bulb held close to the pits. If the left pit is plugged it will only strike when the bulb is held alongside he right pit but not when the bulb is held near the plugged pit and vice versa.

THE BLIND BAT

Of course everybody knows that a bat is almost blind. But he has a radar apparatus worked by sound that enables him to avoid obstacles whilst flying in the dark. Sounds of high frequency and beyond the range of hearing of the human ear are emitted by the bat. These bounce off any obstacles in the path of the creature and are reflected back to its ears. By this means the bat can instantly veer away and so avoid collision.

There is another animal like a kangaroo rat which lives in the desert regions, which is equipped with large resonance chambers in his head, although he is not altogether an idiot. He lives in tunnels and chambers underground and he provides a lot of exits.

It is almost impossible to catch him unless you took a team with you to guard the exits. The slightest noise even of a slithering snake is immediately picked up, and amplified in these resonance chambers which occupy about half his head space. This gives him time to clear out from one of the many exits.

This animal is dumb. To overcome this disability he can give out an alarm by beating the soles of his feet on the ground inside the tunnel. The vibration given out is heard and amplified by his mates.

BEETLE BARRIER

There is a tiny beetle which lives on the bark and wood of the pine tree. The female lays her eggs in a hollow beneath the bark and, when the young ones hatch out, father beetle gets inside and puts his back against the opening. In this way he effectively blocks the entrance and it is almost impossible for marauders to get in.

The hermit crab is an ingenious character. He doesn't bother to grow a hard shell, but hops into the inside of an unoccupied shell of a shell fish. He carries this about with him and lives fairly securely inside. To see him careering around reminds one of an armored tank.

One of the most extraordinary creatures is the African Jerboa. This animal lives in the desert, but is marvellously equipped to escape his enemies. He is only five inches in height and looks something like a little kangaroo.

He can hop 15 or 16 feet just like a kangaroo and can stand erect using his long tail as a third rear leg.

An amazing feature is his eyes. He can see over a radius of 360 degrees without turning his head, so that nothing can take him unawares from anywhere. To prevent him from sinking into the sand his feet are almost all hair and fairly large for his size.

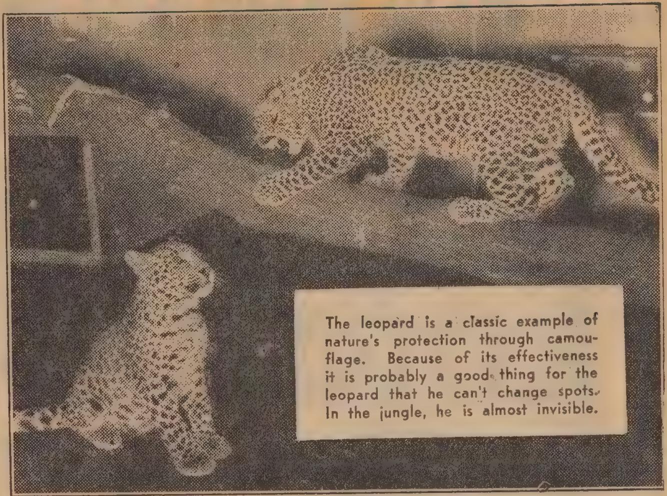
SEA CREATURES

Sea creatures are very versatile in the means they use for defence and offence. There are fish which have a rod-like appendage suspended from the snout. From this dangles a thread-like line which is virtually a fishing rod. Another fish, the Archer fish, varies his diet with insects. Naturally he cannot get above water for this, but he manages quite well with his water pistol. He lurks just beneath the surface until he sees an insect flying close to the surface of the water. He then sticks his nose out and squirts a jet of water from his mouth onto the insect, which falls, slightly the worse for wear, into the water, where it is quickly snapped up by the waiting fish.

Would you pick up a snake with which to ward off an aggressor? Certainly not. Yet a crab living in the Indian Ocean does a similar thing. He carries in each claw a sea anemone which stings. When an attacker menaces him all he does is wave the sea anemones at it and the attacker apologises.

Many pages could be written in this manner about the wonderful ways in which nature has provided defences for her wild creatures. Man has been comparatively slow in adapting some of these measures, but when he has done so it has been to very great effect.

LEOPARD HIDES BEHIND SPOTS



The leopard is a classic example of nature's protection through camouflage. Because of its effectiveness it is probably a good thing for the leopard that he can't change spots. In the jungle, he is almost invisible.

EARTH MAY HAVE ELECTRIC BELT

RESEARCH indicates that invisible band of electricity may circle equatorial area and exert an influence on the earth's magnetic field.

An invisible band of electricity may circle the earth's equatorial area, 12,000 to 16,000 miles in space.

Dr. Sydney Chapman, president of Geodesy and Geophysics, in Great Britain, told the National Science Foundation that his studies point to some extra-terrestrial force that is exerting its influence on the earth's restless magnetic field.

This force might be a ring of electricity girdling the earth like visible rings surround Saturn. It may have been built up over the ages by magnetic storms. It may be the force that keeps the earth's magnetic field from returning to "normal" for several days or a week after a magnetic storm.

Rockets some day may reveal the presence or absence of this ring, Dr. Chapman said. But the ring may lie beyond the range of present-day rockets.

Radar might be used to detect the ring, he added, but it is not likely. Radar waves that could detect the ring would be unable, because of their size to get to it through the earth's ionosphere. Waves which could pierce the ionosphere might be unable to detect the ring.

However, radar carried in high-shooting rockets may be able to spot the ring. The rockets would carry the radar above the ionosphere.

The ring might also be found if radio waves can be rolled out into space on the earth's invisible lines of magnetic force. Some scientists are said to believe this is possible.

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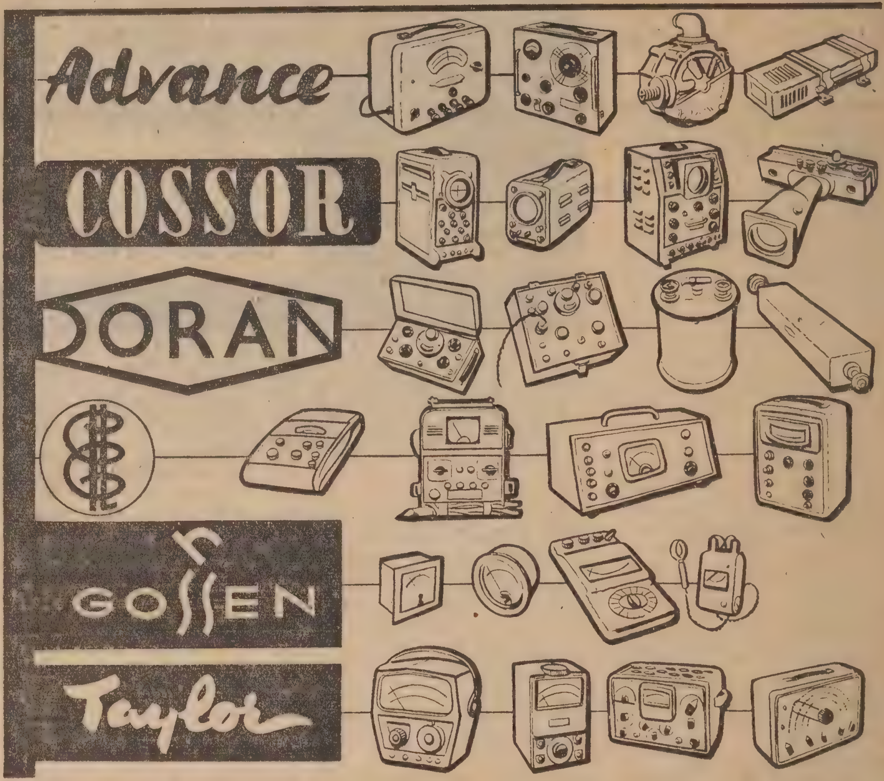

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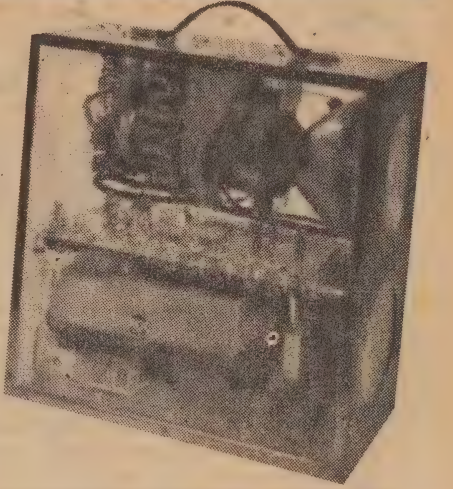
Technical Review

PORTABLE TELEVISION RECEIVER USES TRANSISTORS

We are often asked whether transistors can be used for television. The answer is partly yes and partly no, but details of this experimental receiver made by RCA should throw light on the subject. It demonstrates that there are plenty of clever brains working out ways and means.



The receiver is not yet out of the experimental stage.

THIS article reports on a pioneering attempt to build a television eceiver in which transistors were sed for all the functions performd by vacuum tubes, other than the icture tube (5FP4).

The preliminary result is a singlehannel receiver consuming only 13 vatts of input power.

Of this, 3.6 watts, or more than 5 pc of the total, is consumed by he 5FP4 filament. The entire reeiver is about the size of a portble typewriter case. Complete with atteries it weighs only 27 pounds. As a completely portable set it gives good results in the New York area. This receiver was built in late 1952, nd transistors developed since may llow some circuit simplification.

NO RF STAGE

The set was built to receive sigals from channel 4, the NBC staion in New York. The built-in oop antenna is, therefore, tuned o 67.25 mc. Operating without an RF stage, the oncoming signal is eterodyned with the local oscillator utput in a balanced diode mixer (Fig. 1.)

The oscillator uses a 2N33 high-frequency point-contact type transistor operating in a base feedback type circuit. The frequency of the oscillator was chosen to produce an 3mc picture IF. Following the mixer are six stages comprising the IF amplifier.

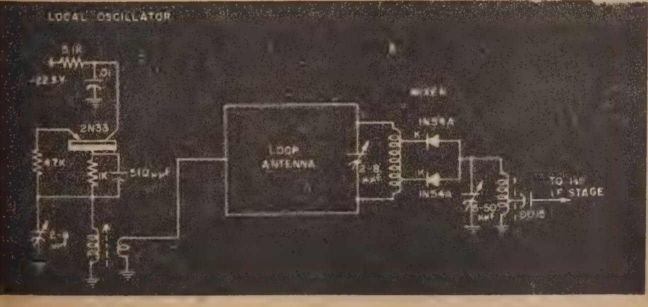


Fig. 1 — Local oscillator-mixer circuits. Transistor and two diodes are used.

All six stages are essentially the same and use point-contact transistors in grounded-base circuits (Fig. 2). A coil wound on a ferrite torroid smaller than a dime provides the inductance for the collector tank circuit of each stage.

Variable capacitors allow these to be stagger-tuned to give the band-width required for intercarrier sound. Impedance matching is obtained by a tap on the inductance.

Good power transfer between the high collector impedance and the low input impedance of the following emitter is thus obtained. The transistors are based at 1-ma emitter current obtained from penlite cells.

Two point-contact transistor second detectors provide optimum paths for the sync and video components of the signal (Figs. 3, 4). The emitters of these detectors are unbiased and act as diode rectifiers.

The rectified signal is internally coupled and amplified by transistor action to the collector circuit. The video amplifier (Fig. 3) uses both a junction and a point-contact transistor. The base-input junction transistor presents a reasonably high input impedance to the second detector and at the same time stabilises the point-contact transistor to the extent that high-frequency positive feedback can be applied in its base circuit.

The 4.5-mc intercarrier sound signal is taken from a trap located in the video second-detector output circuit. Three sound IF stages plus a ratio detector provide the necessary gain for the sound channel.

AUDIO AMPLIFIER

An audio amplifier consisting of one preamplifier stage and a complementary symmetry output stage (Fig. 5) drive a 5-inch speaker. This output stage uses the complementary nature of p-n-p and n-p-n transistors to provide push-pull amplification without a phase inverter. Many novel applications of this circuit have been published.

The signal obtained from the sync second detector (Fig. 4) is coupled to a junction transistor which acts as a sync separator. The sync signal is positive and causes the emitter junction of the p-n-p transistor to conduct on the sync tips. The charge deposited on the coupling capacitor by this conduction keeps the transistor cut off between sync

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pulses. The pulses themselves are nternally coupled to the collector nd after amplification are fed to he horizontal AFC circuit and the vertical integrator.

The vertical pulse from the printed-circuit integrator is amplified and hen used to trigger the vertical oscillator (Fig. 6). This oscillator uses the negative-resistance region of a point-contact transistor to provide free-running oscillations with a sawtooth waveform. The sawtooth s then amplified and applied to a complementary symmetry output stage. This type output stage allows direct coupling to the yoke without he presence of decentering current.

The horizontal scanning circuits use AFC (Fig. 7). These circuits make use of the symmetrical characteristics of individual junction transistors.

NO HEATERS

Unlike vacuum tubes, where one of the elements must be heated to give off electrons, transistors require only the application of the proper potentials for current flow. Thus in an alloy p-n-p junction transistor, either junction may emit holes and the other collect them.

Proper design can make the two junctions exactly alike, and both can act either as emitter or collector. This property may be used to make an extremely simple phase detector. The horizontal AFC circuit compares the horizontal sync pulse to the scanning sawtooth. If they are not phased properly, a correction signal is produced.

A sawtooth signal is taken from the horizontal deflection yoke. This may be obtained from a small resistor in series with the yoke, thus giving a voltage proportional to the current, or it can be obtained from an R-C circuit across the yoke.

The sawtooth voltage which appears across the capacitor of the integrator is capacitively coupled to the phase-detector transistor so that it appears between the two junctions. If one junction is grounded, the other will go equally positive and negative with respect to ground since the sawtooth loses the DC component in the coupling capacitor.

As long as the transistor does not conduct, there is no DC potential on the ungrounded junction and the filter circuit from this point to the horizontal oscillator frequency-control device will not pass any correcting signal.

SYNC PULSES

When the amplified sync pulses are applied to the base of the phase-detector transistor, the transistor will conduct for the duration of the sync pulse. The direction of current flow through the transistor when it conducts is determined by the instantaneous voltage on the junctions.

If the horizontal oscillator is running at exactly the correct frequency and phase, the voltage on the ungrounded junction will go from positive to negative in the sweep return portion of the sawtooth.

If the phase is correct, the currents will be equal and no unbalanced-charge will be left at the end of the sync pulse conduction period. If the oscillator begins to run too slow, the sync pulse will occur while the sawtooth voltage on the ungrounded junction is positive and

Close-up of section of the IF strip. Note the small size of the torroids. Trimmers are 8-50 pf.

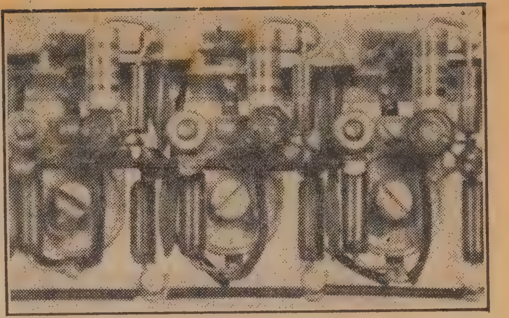


Fig. 2—A typical transistor IF amplifier stage. Six are used in the set.

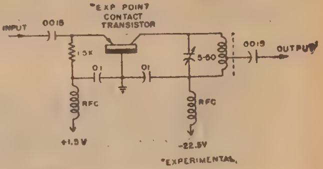
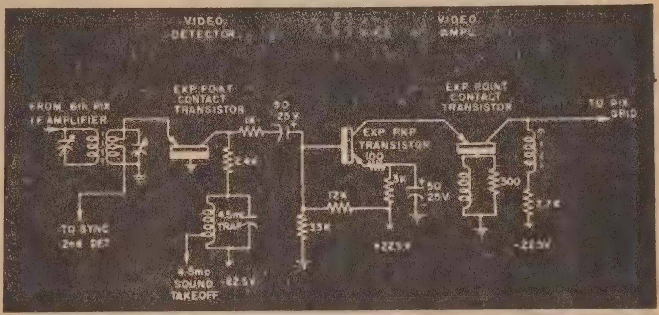

*EXP POINT CONTACT TRANSISTOR
INPUT
.0018
1.5K
.01
.01
5-50
.0019
OUTPUT
RFC
RFC
+1.5V
-22.5V
*EXPERIMENTAL

Fig. 3—The video detector and grounded - emitter - grounded-base amplifier. (Below.)


VIDEO DETECTOR
VIDEO AMPL
FROM 6th PIX IF AMPLIFIER
EXP POINT CONTACT TRANSISTOR
1K
50 25V
EXP PNP TRANSISTOR
100
EXP POINT CONTACT TRANSISTOR
TO PIX GRID
2.4K
4.5mc TRAP
TO SYNC 2nd DET
4.5mc SOUND TAKEOFF
22.5V
33K
12K
3K
50 25V
+22.5V
500
-22.5V

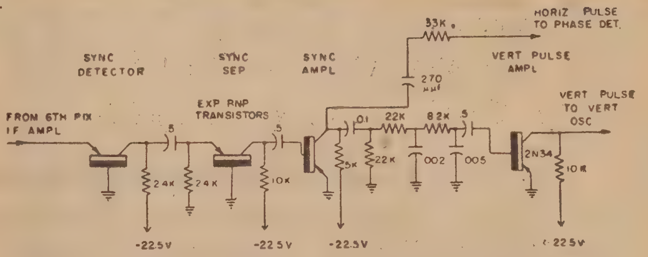

HORIZ PULSE TO PHASE DET.
33K
SYNC DETECTOR
SYNC SEP
SYNC AMPL
270 μμf
VERT PULSE AMPL
EXP PNP TRANSISTORS
FROM 6TH PIX IF AMPL
.5
.5
.01
22K
8.2K
.5
VERT PULSE TO VERT OSC
2N34
24K
24K
10K
5K
22K
.002
.005
10K
-22.5V
-22.5V
-22.5V
-22.5V

Fig. 4—The sync separator and amplifier sections which use four transistors.

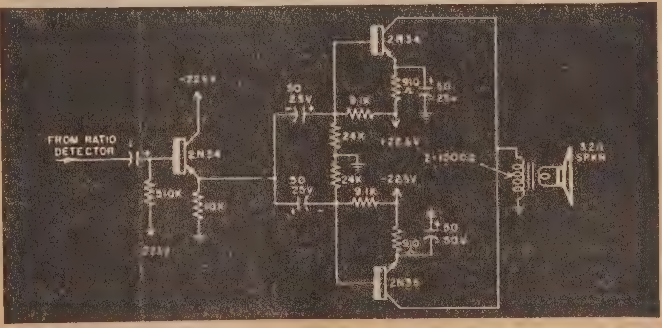

2N34
-22.5V
50 25V
9.1K
910
50 25V
FROM RATIO DETECTOR
2N34
24K
+22.5V
2:1500Ω
3.2Ω SPKR
24K
-22.5V
50 25V
9.1K
510K
10K
22.5V
50 50V
910
2N34

Fig. 5—The audio amplifier and complementary symmetry audio output stage.

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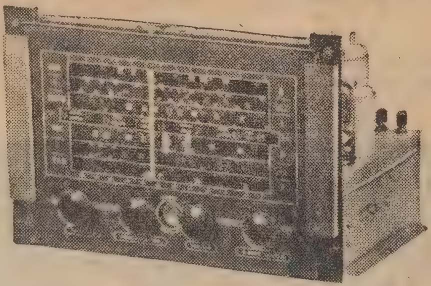

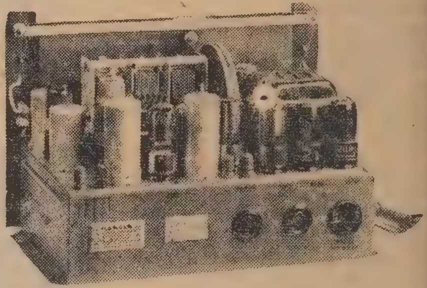

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this junction will act as the emitter positive current flowing to ground and leaving the coupling capacitor with an incremental charge. This charge causes to appear on the ungrounded junction a negative potential which is passed through a filter to the oscillator frequency control device. If the oscillator runs too fast, the output is positive.

This circuit consists of a pulse generator using the negatitve-resistance effect found in a point-contact transistor. Its operation is similar to that of the vertical oscillator. The component values are different, however, to give the proper frequency and pulse output rather than sawtooth.

The rate at which this oscillator runs is determined by the RC time constant associated with the .015uf capacitor between the emitter and collector of the transistor. As long as there is sufficient amount of charging current flowing through the emitter resistor, the transistor is kept non-conductive. When the current falls below a critical value, the potential at the emitter permits conduction which is regenerative.

If the effective resistance of the charging circuit is changed, the rate of oscillation will change. The effective resistance of the emitter resistor can be changed by shunting it with a transistor. This transistor has a certain quiescent bias causing a pre-fixed amount of current to flow.

FREQUENCY ADJUSTMENT

The variable resistor in series with the oscillator emitter is adjusted to nearly the correct frequency as is normally done with the horizontal hold control on TV sets. The phase detector then provides an output which is applied to the base of the transistor, shunting the oscillator emitter resistance. The control signal changes the conduction of this transistor, changing the frequency of the oscillator.

If the oscillator is running too slow, a negative output will be obtained from the phase detector. When this negative signal is applied to the p-n-p transistor shunting the oscillator emitter resistor, its conduction will increase, thus allowing the charging capacitor to charge more rapidly and the oscillator to increase its frequency.

The output pulses of the oscillator are amplified by a complementary symmetry pulse amplifier and then applied to a "totem pole" power amplifier (Fig. 8). This is a regenerative type pulser which switches the bases of the output transistors from a large negative bias present during forward trace to a large positive bias which cuts the output transistors off during retrace. The output transistors are directly connected to the horizontal yoke and act like a switch which connects the yoke to a battery, on forward trace and open-circuits the yoke to cause retrace.

The pulses which occur across the yoke are used to drive a 2-stage class-B amplifier (Fig. 9). The final stage works into a stepup transformer tuned to the horizontal line frequency. The secondary voltage is rectified by a selenium rectifier and provides 2000 volts for the second anode of the picture tube.

—Radio Electronics.

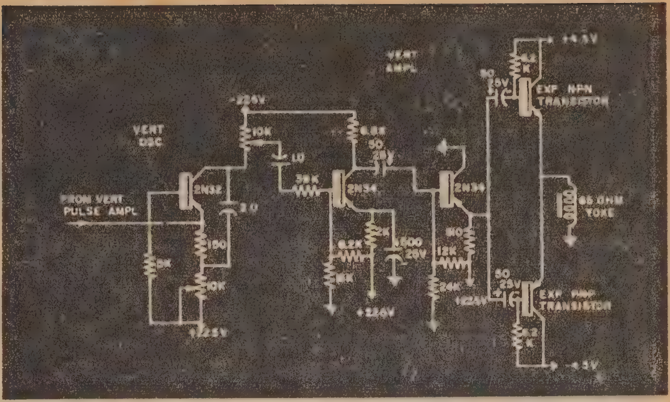
VERT AMPL
+4.5V
6.2 K
50 25V
EXP NPN TRANSISTOR
-22.5V
VERT OSC
10K
6.8K
50 25V
1.0
39K
2N32
2N34
2N34
FROM VERT PULSE AMPL
2.0
85 OHM YOKE
150
6.2K
2K
1000 25V
110
12K
5K
10K
18K
24K
+22.5V
50 25V
EXP PNP TRANSISTOR
+22.5V
6.2 K
-4.5V

Fig. 6—The five-transistor vertical deflection circuit is rather elaborate.

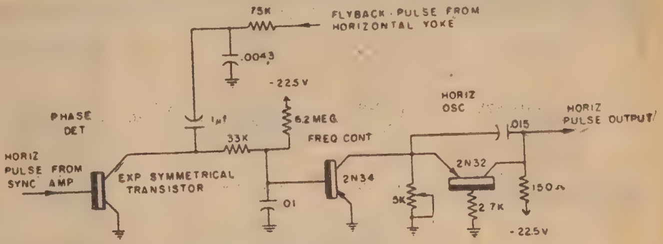
75K
FLYBACK PULSE FROM HORIZONTAL YOKE
.0043
-22.5V
PHASE DET
1µf
6.2 MEG
HORIZ OSC
.015
HORIZ PULSE OUTPUT
33K
FREQ CONT
HORIZ PULSE FROM SYNC AMP
EXP SYMMETRICAL TRANSISTOR
2N32
2N34
150Ω
.01
5K
2.7K
-22.5V

Fig. 7—The horizontal AFC system depends on a symmetrical transistor.

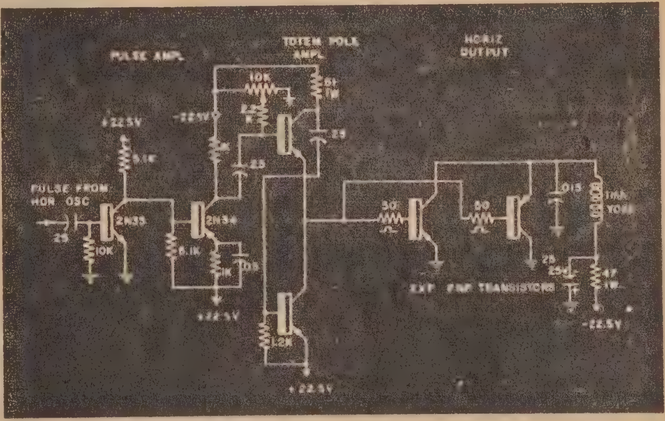
PULSE AMPL
TOTEM POLE AMPL
HORIZ OUTPUT
10K
51 1W
+22.5V
-22.5V
2.2 K
.25
5.1K
.25
PULSE FROM HOR OSC
2N33
2N34
50
50
.015
1MH YOKE
25
10K
5.1K
1K
.05
25 25V
47 1W
EXP PNP TRANSISTORS
+22.5V
1.2K
-22.5V
+22.5V

Fig. 8—The horizontal deflection system—another ingenious use.

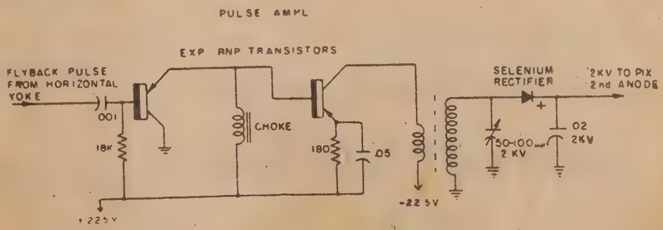
PULSE AMPL
EXP PNP TRANSISTORS
FLYBACK PULSE FROM HORIZONTAL YOKE
SELENIUM RECTIFIER
2KV TO PIX 2nd ANODE
.001
CHOKE
+
.02 2KV
18K
180
.05
50-100 µµf 2 KV
+22.5V
-22.5V

Fig. 9—Even the high voltage supply in this receiver has been transistorised.

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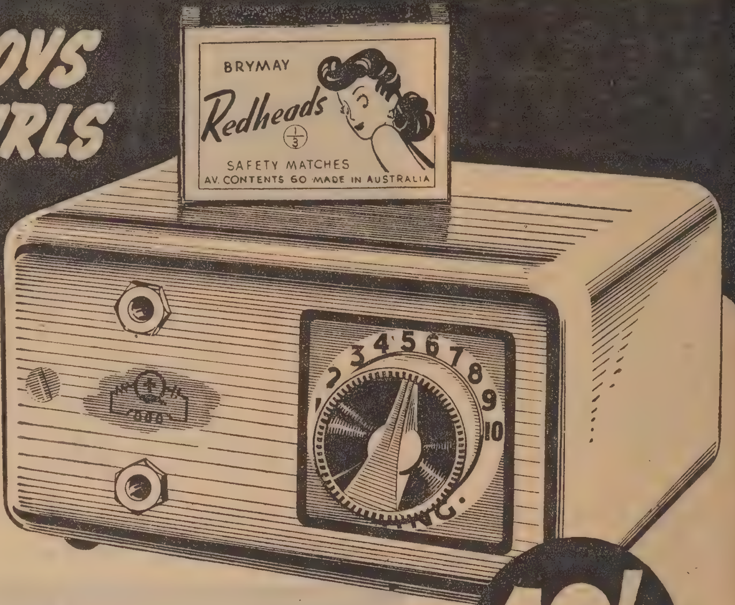
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MANY USES FOR UNDERWATER TV

Without gaining very much publicity, underwater television is being applied these days, in Britain, to many important tasks. Housed in a leakproof casing, designed to withstand enormous pressures, TV cameras more mobile than heavy clad divers, are able to stay submerged indefinitely and can "see" more in the murky depths.

THE TV camera has already proved itself an invaluable tool for the wreck salvager, the harbor engineer, the ship repairer, the naval architect, the designer of defences against coastal erosion, the marine biologist and the oceanographer.

Underwater television might have been born in any maritime country, had the incentive occurred. It so happened that such an incentive was given to Britain by the tragic loss of the submarine Affray on April 16, 1951.

Not one of those aboard her was saved and the only means of discovering the cause of the disaster was to locate and examine the wreck.

Believing that television might possibly be of some use, the Admiralty had the Marconi Company make a camera that would work in 250 feet of water.

In less than five weeks, the complete apparatus was designed, manufactured, and installed in the salvage vessel Reclaim.

A wreck, believed to be that of the Affray, had been located by sweepers in 280 feet of water in a region particularly difficult for divers because of the strong currents and heavy seas prevailing there.

The salvage ship steamed to the spot. The camera was lowered and slowly moved from point to point about the wreck. Detail after detail was clearly seen.

DRAMATIC PICTURE

Then came the moment when perhaps the most dramatic television image ever seen appeared on the screen, the Affray's nameplate, plain to read.

As the examination of the wreck went on submarine television proved its value again and again. With its help, for example, a diver can be sent straight to the place where he is wanted.

The diver's descent is always guided by a shot rope (a cable with a heavy weight at its end). Without TV it is impossible to know whether or not the shot rope is in the right place until the diver reaches the bottom.

He cannot move more than a foot or two from the rope when wearing armored deep-water dress; if its position is wrong, the diver must be brought up and the entire process repeated.

But raising a diver from deep water to the surface is so slow a process that often only a single dive can be made during each tide —and there is no certainty that the shot rope will be properly placed at the next attempt.

With TV there is no element of chance and no waste of time or of the diver's energy.

He does not go down until the rope is seen on the receiver screen to be in the right position; he can be shown, too, just what he is wanted to examine.

The best of divers can work for no more than a few minutes in very deep water; the TV camera stays on the job for hours on end. Unlike the diver, it can be moved as required.

LIMITED VISION

During the work on the wreck of the Affray the range of diver's vision was no more than five feet. Owing to the sensitivity of the image orthicon, the TV camera "saw" clearly through 15 feet of dim water. The diver can make no records, other than reports by telephone, of what he finds.

The latest TV equipment for salvage work developed by Marconi is capable of working down to at least 500 feet. It is lowered on a nonspin cable, to which the multicore electric cable is attached.

By R. W. HALLOWS

A tubular frame carries the lights and the camera itself. The latter has a trunnion mounting and can be moved from the surface through 90 degrees vertically; any "take" from straight ahead to straight down can thus be made. The lights, also controlled from the surface, are ordinary 200-watt tungsten lamps. These have so far been found to give the best lighting, down to about 700-800 feet.

Though the pressures at such depths are in the order of 20-25 atmospheres (300-375 pounds per square inch), unprotected lamp bulbs are not crushed, as it might be expected they would be.

Direct contact with the water keeps the bulbs cool and they can therefore be made smaller and of thicker glass if necessary.

Mercury arc lamps can be used at depths of thousands of feet.

All remote controls of the camera, as well as the main viewing C-R tube, are mounted in a compact monitor unit. The unit allows the focus, the iris diaphragm and the lighting to be adjusted, no matter at what depth the camera is working.

If a turret lens is used, it is also remotely controlled.

Indicating dials at the monitor include an inclinometer, showing the vertical angle of the camera, a compass showing the bearing on which it is pointing, a humidity meter, giving warning of excessive moisture in the armored case containing the camera, and a tell-tale showing whether or not the heater is maintaining the proper temperature for the image orthicon to work most efficiently.

A recent refinement is the addition of a vision radio link with a normal range of over 30 miles. This enables experts ashore to be consulted when any specially difficult salvage problem arises.

Underwater TV equipment of this kind is fast becoming standard gear on salvage vessels. It is also of great value to engineers in charge of docks and defences against the sea.

Turbidity of the water is the main difficulty here; but one means of overcoming this is already being developed. This consists of fixing to the front of the camera casing a funnel-shaped closed tube filled with clear water.

An engineer can sit in his office ashore with a plan of the harbor he is inspecting before him. A vessel carrying TV gear and a radio link is directed to point after point by the engineer, who is able to conduct a minute inspection by watching his receiving screen and making permanent photographic records of anything requiring minute study.

Such inspections have become routine in the clear waters of the Mediterranean Sea.

SPECIAL CAMERA

For some time the Scottish Marine Biological Association has been making successful use of submarine TV in its 75ft research vessel Calanus. A smaller and lighter camera for this kind of work has been developed by EMI.

Many different kinds of images are needed, ranging from whole shoals of fish or large areas of the sea-bed to detailed close-ups of individual small creatures. The camera is therefore fitted with a 6-lens turret.

Dr. H. Barnes, in charge of this research, reports excellent results and predicts a big future for underwater TV in this field. It can be used, for example, to examine oyster and clam beds as well as to study the enemies of the shellfish and their methods. Dr. Barnes found that with the help of TV he could easily and quickly carry out fish counts in selected areas.

A color-printer named Hermann wanted a fresh market for his wares in Vienna some 85 years ago, and so he thought up the world's first picture postcard. Within twelve months the novelty had spread all over Europe, and today millions of postcards circulate throughout the world. Originally, the number of permissible words, including signature and address, was limited to twenty. Consequently, British postal authorities were nonplussed when one postcard passed through their hands—it contained 15,000 words of microscopic writing!

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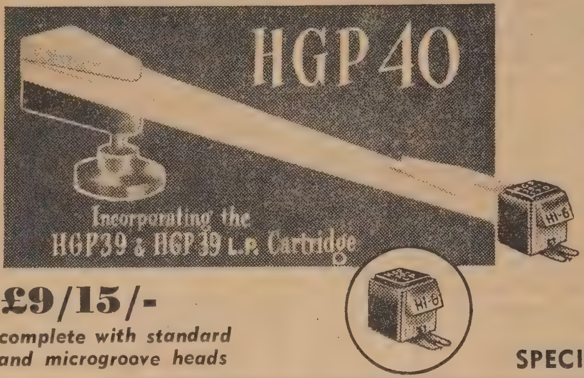

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NEWS AND VIEWS OF THE MONTH

Saucers again

WHETHER flying saucers are fact or fiction is as controversial a ubject as ever, and there appears o be little prospect of any solution o the problem in the immediate uture. No sooner does one authorty label them as figments of the magination than another, equally repectable, produces convincing argument that they do, in fact, exist.

The latest supporter for the exstence of these devices is an Engish airman who has commenced publication of a magazine devoted o reporting sightings of these mysterious craft.

Called the Flying Saucer Review, it is edited by former RAF instructor Derek Dempster, who has never seen one, but believes firmly in their existence.

He said, "When the idea was first mooted, we had thousands of letters from all over the world from interested people.

"Dozens came from flying saucer clubs in Australia."

First issue of the magazine contains a number of reports from pilots of strange phenomena.

Flight-Lieutenant J. R. Salandin said that while piloting a Meteor at 16,000ft he looked into his windscreen and "saw an object coming straight for me."

It had a bun-shaped top, a flange like two saucers in the middle, and a bun underneath.

It flashed past at terrific speed and "I had to stooge around quietly for about 10 minutes to recover from the shock," he said.

Dempster thinks saucers must come from a planet—which one, he cannot even guess.

He has been studying them for eight years and says he will only publish reports of those which are authentic.

* * *

Transatlantic TV

ALTHOUGH normally regarded as "impossible" by present day standards it is significant that engineers are devoting a lot of time to the problem of transatlantic TV.

Sir George Barnes, director of British television, disclosed that British and American scientists are carrying out research into the possibilities of such a link.

But he made plain that it is still far from the realm of the engineers.

He believed that it might be possible to increase the distance between micro-wave "hops" from between 30 and 50 miles to about 150 miles.

Increasing these "hops" to between 2000 and 3000 miles, or thereabouts, he said, was an infinitely greater task.

British television enthusiasts first demonstrated the possibility of transmitting television programs across the English Channel with a broadcast from Calais in August, 1950.

* * *

New rocket engine

ONE of the latest contributions by Britain to jet and rocket propulsion is the development of the de Havilland Super Sprite rocket engine. Already passed by the Ministry of Supply for quantity production and service use it heralds a new era in aero engine development.

It is only 10 years since the first British jet aero-engine, the de Havilland Goblin, was similarly approved for service in February, 1945. Now future use of rocket engines, particularly for short-range interception duties and guided missile propulsion, can be confidently expected.

The Super Sprite burns hydrogen peroxide as its fuel, in conjunction with a metal catalyst. Its thrust is increased by after-burning kerosene or gasolene, giving a maximum thrust of 4200lb and a duration of

POPULAR SCIENCE QUIZ

Q. What future has the metal magnesium in the aircraft industry?

A. In all probability, a very bright one. During the last war, when aluminium became scarce, magnesium found free use in motor components and even, on an experimental basis, in certain parts of the airframe.

Just recently, two Sabre jets were completed, using airframes made almost completely from magnesium. Engineers point out that the supplies of magnesium are almost inexhaustible and that it is an excellent material to use in positions where resistance to buckling is important.

Q. Can you imagine any possible connection between pig-raising and the use of infra-red lamps?

A. To be sure, the connection may not be immediately obvious. However, the US State Department of Agriculture has demonstrated that pig farmers can save money by spending it on infrared equipment!

They discovered that three-fourths of the 3-million pigs lost to the industry each year die in their first two days after birth. Some die from cold and exposure, others from crushing when the sow lies on them in her clumsy attempts to keep the piglets warm.

The use of infra-red lamps reduces both hazards. Every pig saved in this way covers the running cost of a lamp for about two weeks, which adds up to quite a good bargain.

Q. Plastic-bodied cars are now fairly commonplace. Are these the largest plastic "structures" in existence?

A. Not by a long way. The US Army is at present developing a huge plastic barge for the transport of men and equipment over water. The developmental craft is 51ft long and weighs 10.2 tons.

The hull is constructed of phenolic impregnated cotton duck sandwiched between two sheets of plastic, reinforced by glass fibre. Moulded in a large plywood form, it is reckoned to be the largest reinforced plastic structure ever built.

When carrying a load of five tons, the barge has a draught of only 21in. Powered with two 165 hp diesel motors, one such barge can push a fleet of non-powered barges carrying 100 tons of equipment.

Q. What is a "Bubble-Chamber"?

A. It has nothing whatever to do with soft drinks, as the name might suggest. It is, in fact, a compact adaption of the "Cloud Chamber" principle, used to track the passage of sub-atomic particles.

The Bubble Chamber, which can afford to be only a fraction the size of a Cloud Chamber, is a quart-sized container of clear, super-heated pentane petroleum fraction, kept under high pressure to delay its boiling.

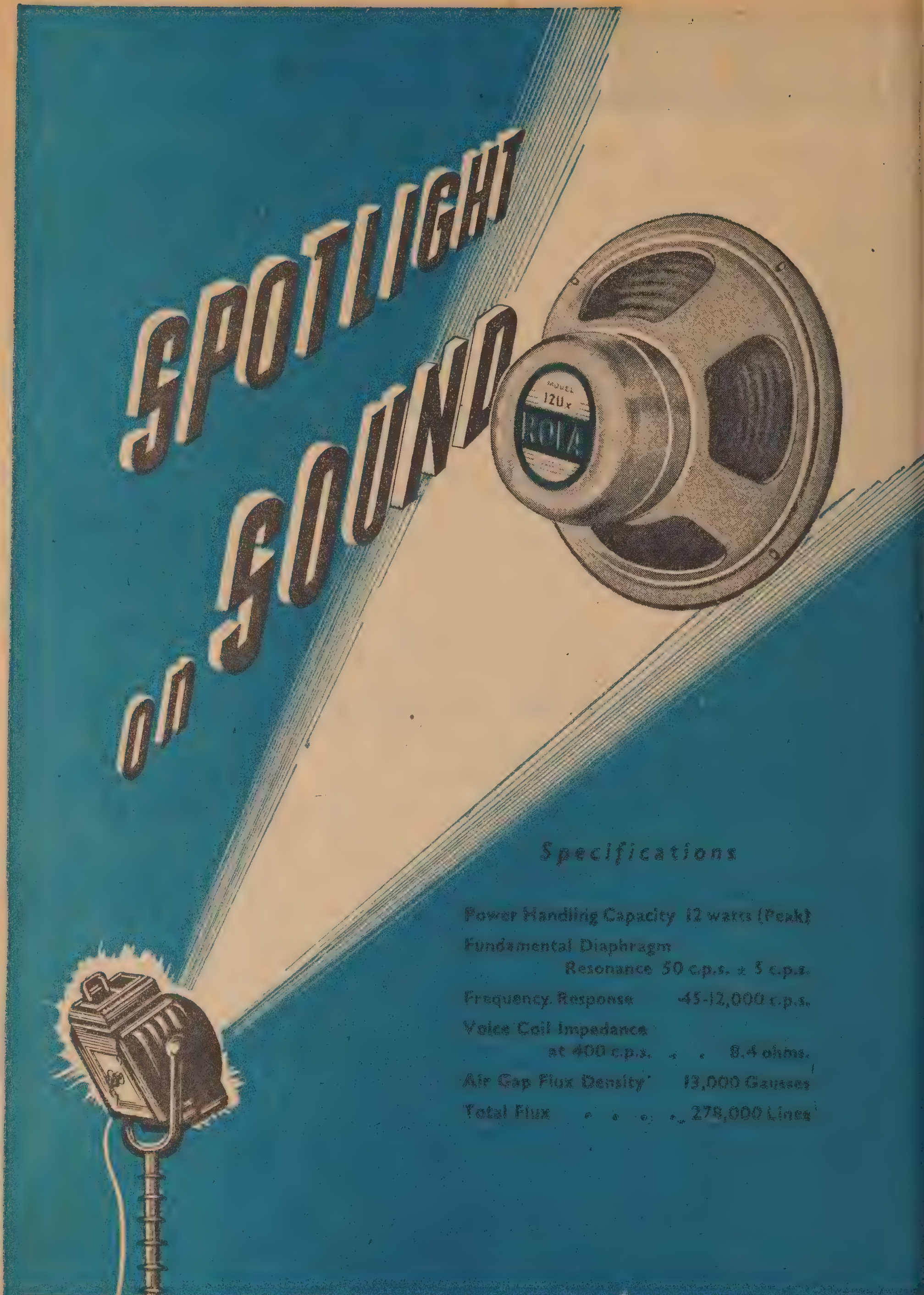
Sub-atomic articles plunging through it set up trains of bubbles which can be photographed and analysed.

Q. Some people are credited with keen eyesight or perhaps keen hearing. But is this "keenness" a constant figure?

A. No, it isn't, by any means. Both the eye and the ear tend to adapt themselves to prevailing conditions and also to raise a temporary barrier against very high level excitation.

A person who glances into the sun—not a very wise procedure—finds that his eyes are insensitive for a time to low degrees of illumination. Similarly, ears that have had to listen to the blast of a jet plane at close range may not be able for a time to hear their accustomed whisper of sound.

It has been calculated that the effect on the ear of a noisy subway is about equivalent to the effect on the eye of looking straight at a fluorescent light. And aviation has provided the equivalent of looking at the sun, as far as the ear is concerned. This "ultimate" sound is that produced by a large jet motor with afterburner. Tests show that it can temporarily raise the threshold of normal ears by as much as 60 decibels.



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0 seconds. The total impulse is 20,000lb—seconds, for a weight of only 620lb when dry.

The special features of a rocket engine can be briefly described. The rocket gives tremendous thrust for ts weight and frontal area (which produces drag), but the drawback is ts high fuel consumption. This s such that the use of rockets is confined to duties of short duration. The rocket's thrust is almost independent of the altitude and forward speed of the aircraft, so that for heights above 60,000ft it is particuarly suitable. It may be used for assisted take-off, climb boosting and acceleration in level flight. Rockets could also be used to increase the eiling of bombers over a target makng it difficult for enemy fighters to ntercept the raiders.

★ ★ ★

Pedal-powered sub.

CONTRASTING with many stories concerning Nautilus—the US Navy's atom powered submarine which is generally regarded as the most powerful craft of its kind ever produced—there comes a story from Bilbao in Spain of what must be the world's lowest powered submarne. It is called Bermudez, after its inventor.

Senor Bermudez and his son have made several dives in the port of Santurce.

Power for diving is provided by the occupants' pedalling.

According to the newspaper Informaciones, the small submarine handled well and "went down and came up satisfactorily".

★ ★ ★

Radar with brains

SINCE the radar screen monitoring system was first introduced, there has been a constant search for new techniques and refinements to increase the reliability and accuracy of the procedure by which the small blip on the cathode ray tube (which may be an enemy bomber) is identified and its position plotted and information about it passed on for operational use.

British experts are considering the possibility of linking radar with electronic computers (so-called electronic "brains") for the defence system so as to give an automatic warning of danger when unidentified aircraft are picked up by the radar network.

Among the techniques being considered is one where information from the radar system fed into the computer would be compared with a reference or "safety" pattern. If a dangerous situation developed, the system would automatically operate an alarm—"Let out a yell" as one expert described it. The basic idea is also applicable to monitoring systems for the commercial airways.

The automatic warning system, still very much in the future, is one of the many methods being examined by experts in their continual search for the perfect radar "watchdog".

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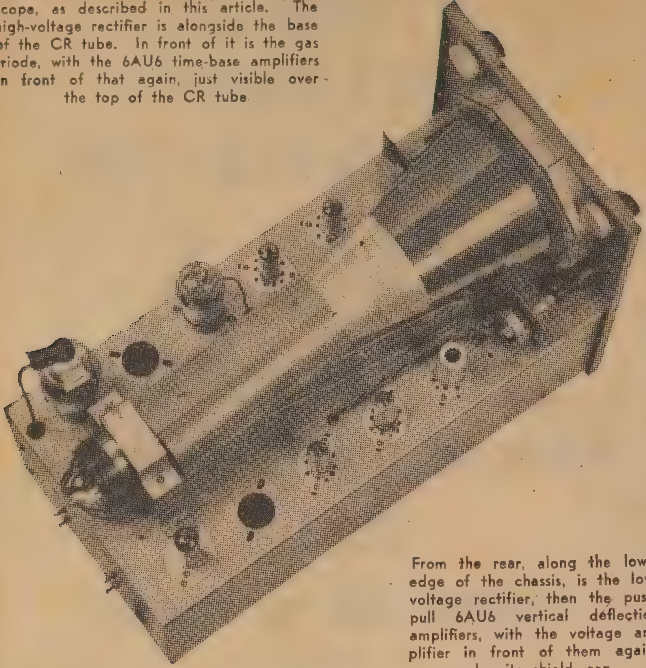

A rear view of the modified 5-inch Oscilloscope, as described in this article. The high-voltage rectifier is alongside the base of the CR tube. In front of it is the gas triode, with the 6AU6 time-base amplifiers in front of that again, just visible over the top of the CR tube.

From the rear, along the lower edge of the chassis, is the low-voltage rectifier, then the push-pull 6AU6 vertical deflection amplifiers, with the voltage amplifier in front of them again, under its shield can.

IMPROVING THE CRO TIME BASE

Having last month, discussed the design of vertical deflection amplifiers, we come this month to a discussion of time-base amplifiers and their influence on the final pattern, as viewed on the screen. Information is given which will be of direct interest to those who have built up the "Standard 5-inch Oscilloscope".

by W. N. Williams

THE subject of time bases has long been a classic and numerous articles and books have been written about their design and operation.

Over the years, time-base circuits have evolved from the simple neon-tube relaxation oscillator to the varied and often involved circuits required by radar and television apparatus—and the test equipment that goes with it.

While we may shortly have to concern ourselves with such circuits, the immediate purpose of this article is to discuss the kind of time-base that is used in most general-purpose oscilloscopes. We refer, of course, to the familiar gas-triode discharge circuit.

VERY CONVENIENT

While this device has certain definite limitations, they are generally not sufficient to outweigh its undoubted convenience and reliability for routine audio testing.

In point of fact, the performance of a well-designed gas triode oscillator is often a lot better than the deflection amplifiers, which are designed to work with it. As a result, the amplifiers rather than the oscillator limit the ultimate usefulness of the instrument. Just how true this can be will emerge as the article progresses.

Figure 1a depicts the kind of output waveform that is normlly required from a time-base oscillator—or "sweep generator" or "sawtoot oscillator"—to call it by a variet of names.

When applied through the amplifiers to deflect the electron beam the scanning spot is moved acros the screen at a perfectly regula rate. It is then flicked back t its starting point almost instantaneously to recommence the operation. So the cycle of events continues.

By suitably synchronising th "sawtooth" repetition rate with th signal on the vertical plates, th scanning spot is made to follow recurring path on the screen, whic the eye resolves as a stationary pattern of waves.

It sees (or should see) only th pattern produced by the "forward trace, the "return" trace being to fast either to produce any usefu pattern or even to illuminate th screen.

PRACTICAL CASE

As might be expected, a practical time-base does not have th ideal characteristics suggested b figure 1a, although a well designe sweep oscillator may approach i very closely.

There is a tendency for the lon side of the sawtooth wave to b slightly curved, rather than absolutely straight. The corners become rounded and what should be a vertical retrace line shows a tendency to lean slightly.

In other words, the waveform tends to the shape illustrated in figure 1b.

The effect of this on the final pattern, we shall see a little later

The basic circuit of a gas triode time-base oscillator is illustrated in figure 2.

When HT is applied to the plate supply network, current flows through it and begins to charge the particular storage capacitor which happens to be switched between plate and cathode.

The rate of charge, and, therefore, the rate at which the plate voltage increases, depends on the value of the selected capacitor and the setting of the series potentiometer. (These constitute respectively the "coarse" and "fine" frequency controls on an oscilloscope.)

When the voltage reaches a certain critical figure, the gas in the valve envelope breaks down (or ionises), discharging the capacitor very rapidly to a figure where the voltage across the plate circuit cannot any longer support the ionisation.

The valve then quenches and the plate voltage begins to rise again, to repeat the cycle, ad lib. The

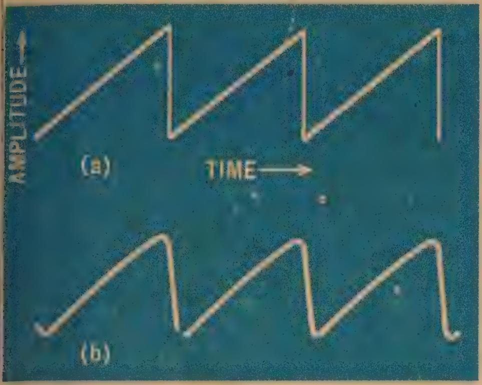

Figure 1. Diagram (a) shows an idealised sawtooth wave, which can be approached but not achieved in practice. From a practical circuit the output wave tends to the configuration shown in diagram (b).

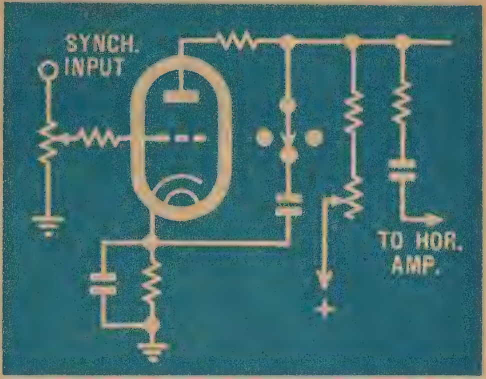

Figure 2: The basic circuit arrangement of a gas-triode sawtooth oscillator. Constants in the plate circuit largely govern the "forward" trace; in discharging, the valve initiates the return trace.

et waveform, available from the utput circuit, is therefore triangu-ar in form, rather like figure 1a.

However, it contains the inherent mperfections of figure 1b, for fair-y obvious reasons.

Firstly, the flow of current into he storage capacitor, which sup-lies the "forward" trace signal is ot a linear function, the rate of harge tending to diminish as the apacitor approaches full charge. (See figure 3a.)

This difficulty can be overcome n part by charging the capacitor from a voltage source much higher than the ionisation voltage of the gas triode. As a result, only a short sector of the exponential charging curve appears in the out-put waveform and such a small sector is fairly close to linear.

It is also possible to improve matters by using another valve to limit and control the rate of charge. So-called "linearising stages" are sometimes used in more elaborate instruments.

The effect of non-linearity on a typical screen pattern is illustrated in figure 3b. It will be seen that the waveform under inspection is opened out where the horizontal sweep potential is changing rapidly, closing up noticeably as the spot slows on its side-to-side travel.

SIGNAL PHASE

The effect may, of course, be apparent in either direction, depending on the phase of the deflection signal.

While non-linearity is undesirable, as a general rule, a moderate degree can be — and often is — tolerated on the grounds that it does not prevent the observer from seeing the kind of effects and distortion that he is normally looking for.

A second point about the gas triode is that, not being a short-circuit, it cannot instantaneously discharge the storage capacitor. What should therefore be a vertical line in the sawtooth wave adopts a definite lean, which is equivalent to the time which the gas triode takes to discharge the capacitor. The result is something like figure 3c.

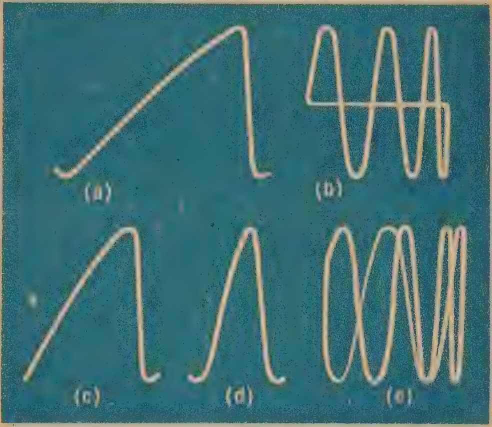

Figure 3: Illustrating how the imperfections of a typical sawtooth wave (a) affect the display (b). At higher frequencies, the wave tends toward (c) and (d) giving a display similar to diagram (e). As explained in the article, this effect is as frequently attributable to amplifier response as it is to imperfections in the time-base oscillator.

Added to this is the fact that the ionisation process within the valve takes a definite time to commence and terminate. The effect is of little consequence at low sweep frequencies but, as the repetition rate is pushed higher, the imperfestions become proportionately more significant. As a result, the idealised waveform of figure 1a gradually deteriorates at high frequencies to the form suggested by figure 3d.

While the limit of usefulness varies widely with different valves and circuit details, it is generally reckoned that gas triode time-bases are not very satisfactory at frequencies above about 20 or 25Kc. This is still sufficient, of course, to portray a pattern of up to at least 100Kc imposed on the vertical plates.

The effect of time-base deterioration as per figure 3d is illustrated in 3e. The "forward" tracing is apparent but a pattern of waves produced by the tardy return trace appears also and at sufficient brilliance to complicate the pattern. The ends of the pattern are also compressed, both by the fundamental non-linearity of the forward trace and by the rounded corners of the "sawtooth."

These rounded corners mean that the spot can be deflected through a large vertical distance without, at the same time, peing moved very far in the horizontal direction.

While all this may seemingly add up to a condemnation of the gas triode circuit, it is not intended to be so. As we said at the outset, the gas triode is very convenient to use and is capable of producing patterns adequate for most audio and supersonic observations.

AMPLIFIERS TO BLAME

That the same cannot be said of all oscilloscopes using a gas triode is, as often as not, blameable on the deflection amplifiers.

The ideal sawtooth (figure 1a) requires a virtually infinite frequency range for its reproduction. In this respect it is similar to square waves which may be applied during testing to the vertical deflection plates.

At the low frequency end of the spectrum, the amplifiers must transmit to the CR tube a deflection signal having a perfectly regular slope or rise time. If the deflection amplifiers contain any R/C circuits, they will tend to impose their own individual time constants on the forward trace.

Taken to the extreme, this could

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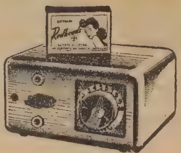

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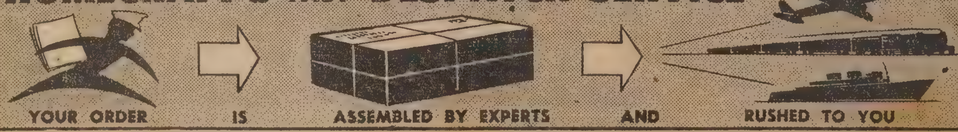

mean that only DC deflection amplifiers could be considered as satisfactory. Fortunately, perhaps, the extreme view is not necessary.

If one accepts the principle that a certain amount of non-linearity is inevitable and tolerable, it becomes permissible, to use a deflection amplifier system which does not too seriously degrade the time-base output. In fact, by balancing one source of non-linearity against the other, it may even be conceivably possible to improve it.

Sufficient to say that, in practice, the deflection amplifier (or amplifiers) must include unusually high values of coupling capacitance between stages and unusually high values of cathode and screen bypass, where these latter are necessary. If they can be eliminated altogether, so much the better.

COUPLING CAPACITORS

It may be recalled that the coupling capacitors in the horizontal sweep circuits of the Standard 5in CRO were made deliberately large in value, with this point in mind. Actually, they are much larger than would be necessary to transmit sine waves of the same frequency.

It is a most important point of design and, before passing judgment on the linearity of a time-base, particularly at very low frequencies, it is always wise to check on the point.

At the other extreme, the instantaneous nature of the return trace depicted in figure 1a requires a virtually infinite frequency response of the horizontal amplifier circuit.

Once again, practical time-base generators do not produce an instantaneous return trace, and, therefore, do not warrant the use of an amplifier with such extreme characteristics. It is sufficient to see that the amplifier does not markedly or further degrade the waveform delivered to it.

If it is assumed that a time-base oscillator can be set for an operating frequency of say 25Kc, then the associated amplifier must obviously be able to handle frequencies of this order without attenuation.

Further, if the time-base output contains sufficient harmonics to make it even partially sawtooth in form, then the amplifiers must pass these harmonics also without serious discrimination.

FREQUENCY LIMITS

In other words, the amplifiers must be capable of handling frequency components up to around the 100Kc mark and ideally beyond that again.

If they cannot do so, then obviously a waveform that feeds into the amplifier as a triangular shape will emerge as almost sinoidal. The nett effect is similar to figures 3d and 3e, except that it will occur at all frequencies above which the response

THE COMPLETE CIRCUIT DIAGRAM

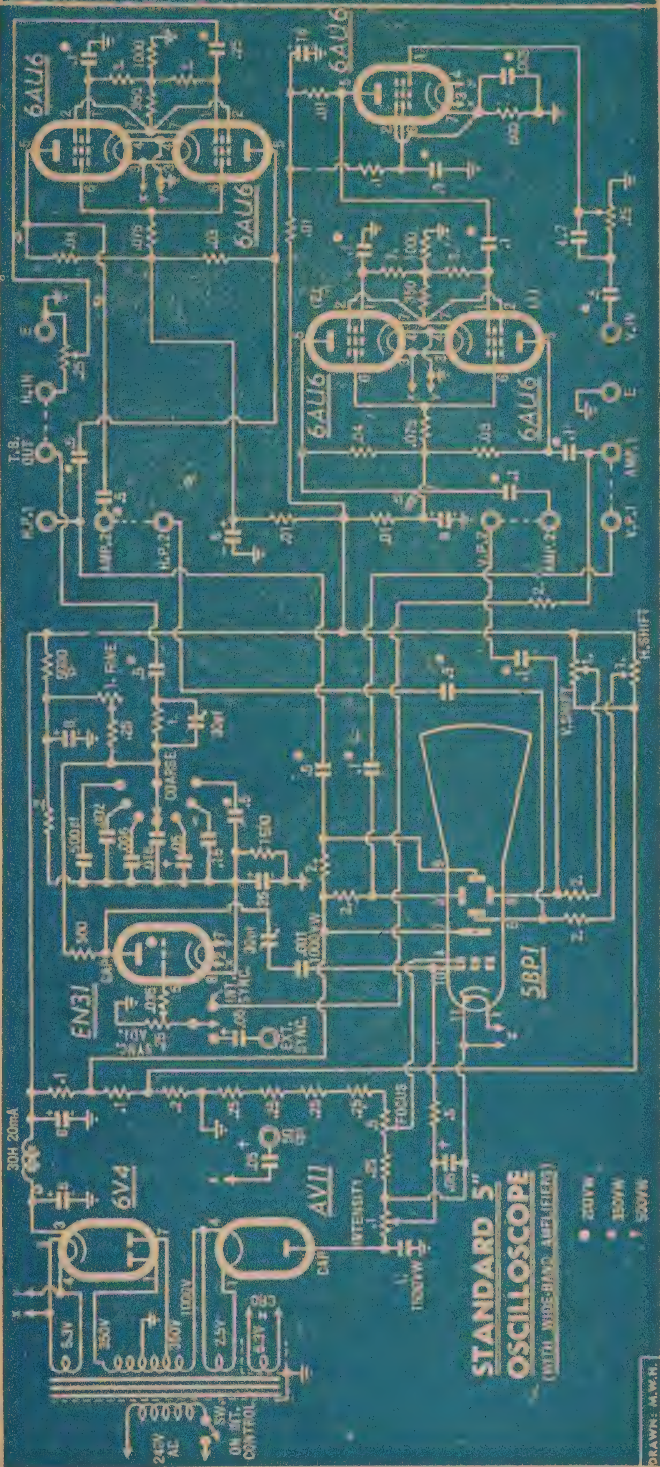

Figure 3: Here is the complete diagram, including extended range amplifiers for both vertical and horizontal deflection. Note that an adjustable trimmer has been connected across the 1.0 meg isolating resistor which feeds the sawtooth signal to the horizontal gain control.

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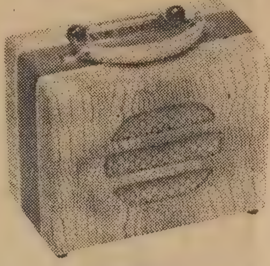
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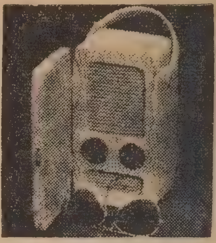
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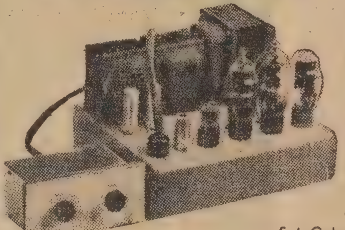

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of the horizontal amplifiers rolls off.

There is, therefore, good reason to suggest that the response of the horizontal amplifiers in a general-purpose oscilloscope must be of the same general order as the vertical amplifiers, if high frequency waveforms are going to be studied or photographed with any degree of clarity.

Needless to say, the shortcomings of vertical amplifiers, as detailed last month, are normally repeated in the horizontal amplifiers and the same remedial measures are called for.

These include:

(1) Elimination of high frequency losses in the input control, due to Miller Effect, &c.

(2) Elimination of losses elsewhere in the input circuit or due to wiring, and

(3) a reduction in plate load values to minimise shunt losses, in interstage coupling circuits.

Since the nature of these losses was discussed at length last month, there is no point in repeating the discussion here. However, a few actual measurements may prove enlightening.

SOME TYPICAL RESPONSE CURVES

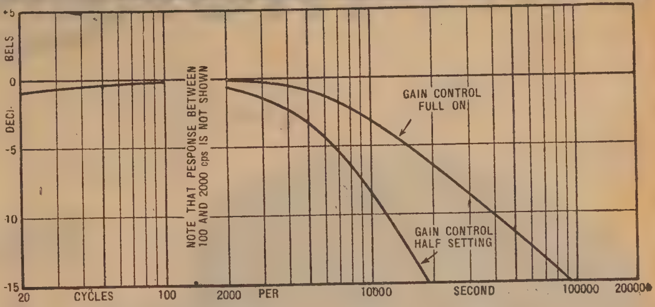

Figure 4: The response curve of the original horizontal deflection amplifier using a push-pull cathode-coupled twin triode. Note once again, the serious additional loss which is introduced by a high resistance gain control.

RESPONSE CURVES

Figure 4 shows the response of the horizontal amplifier in the Standard 5-inch CRO. The original circuit used a twin triode as a cathode-coupled push-pull driver, mainly for reasons of simplicity. Its response is well down with the gain control full on, but it is a lot worse at half-setting, due to Miller Effect.

Clearly, some improvement was called for to bring the instrument up to date, and in line with improvements already effected in the vertical deflection circuits.

Although both curves in figure 4 might have been much improved by lowering the plate loads of the two triode sections, such a step would have drastically reduced both the stage gain and the ability of the valve to supply the necessary deflection voltage.

This latter point is very important because, if the time-base amplifier overloads before the scanning spot is swept off the screen, the pattern tends to merge, each side, into solid lines.

Since power supply limitations prevent the use of high drain video-type stages, our obvious course was to duplicate the stage evolved last month for the vertical amplifiers, using push-pull 6AU6 pentodes. The change could be expected to preserve the necessary voltage swing, greatly reduce Miller Effect, allow the plate loads to be reduced and give a greater margin of gain.

And this is exactly how it worked out. The solid line in figure 5 shows the natural response of the new stage, which looks to be as good at 100 Kc as did the original at 10Kc!

LOWER VALUE

As before, however, it became evident that this order of response could not be preserved if the stage were fed through a 1-meg gain control. A 0.25 meg. pot. was obviously the largest value which could be tolerated. How would this affect the overall deflection sensitivity?

Examination of the circuit shows that the horizontal deflection amplifier is fed from the time-base circuit through a series 1.0 meg. resistor. This resistor, forming a voltage divider with the 0.25 meg. pot, would apply only one fifth of the available signal to the amplifier, against the previous figure of one-half.

However, such is the gain of the pentode stage that this is ample signal and the beam can be swung at all frequencies well beyond the confines of the screen.

But what of the 1.0 meg. series resistor? What effect would it have on high frequency response?

As we anticipated, the answer proved to be "a very serious one," verified by feeding an audio generator into the remote end of this resistor and observing the deflection response on the face of the CRO tube.

ITS FUNCTION

The resistor is actually included in the circuit to isolate the time-base from the rest of the circuit—and it certainly does isolate it as far as high frequency transients are concerned! Yet the resistor appears almost as a standard fitment in general-purpose oscilloscopes.

Very obviously, loss of high frequency (or transient) response across this isolating resistor must be eliminated if the "flyback" characteristic of the time-base oscillator is to be preserved.

In our case, compensation proved to be simply a matter of connecting a very small capacitor across the offending resistor.

Its measured value happened to be 10pf, but we suggest the use of a 3-30 pf trimmer, similar to the one used for flyback erase. With a stationary pattern of waves on the screen, say at about 50Kc, the trimmer can be adjusted to give the best overall linearity and the least interference from the flyback pattern.

The capacitance is far too small to reflect any back-loading on the normal charging cycle, so that it does not affect the opeartion of the time base.

In adjustitng the trimmer, compensation is made automatically for the slight drop in amplifier response and for the further and variable loss across the amplifier input control. The dashed curve in figure 5 shows the measured response from the remote end of the 1.0 meg. resistor to the deflection pattern on the screen, with the horizontal gain full on.

The dotted curve shows the slight degree of over-compensation that occurs when the gain control potentiometer is backed off to about half setting.

ACTUAL TRACINGS

What all this means in practice is best illustrated by reference to figure 6, which shows a variety of tracings taken directly from the CRO screen. The exact wave shapes may have suffered slightly by the process of tracing, copying and reproduction, but they are fairly close to the mark.

Figure 5a shows a single 50-cycle wave and below it (5d) the sawtooth wave which produced it. This for the time-base amplifier in its original form.

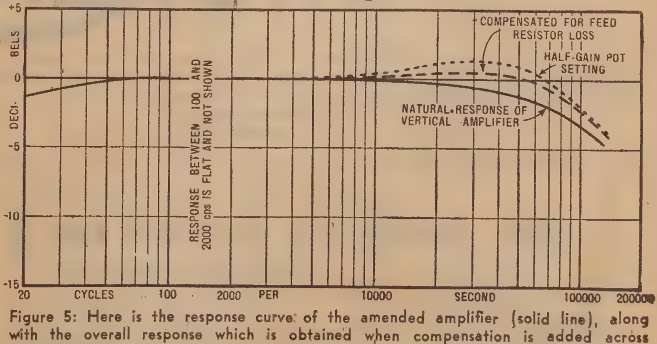

Figure 5: Here is the response curve of the amended amplifier (solid line), along with the overall response which is obtained when compensation is added across the series feed resistor. The improved display which becomes possible is illustrated in figure 6.

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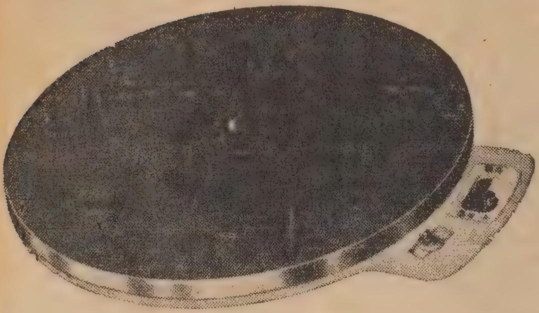

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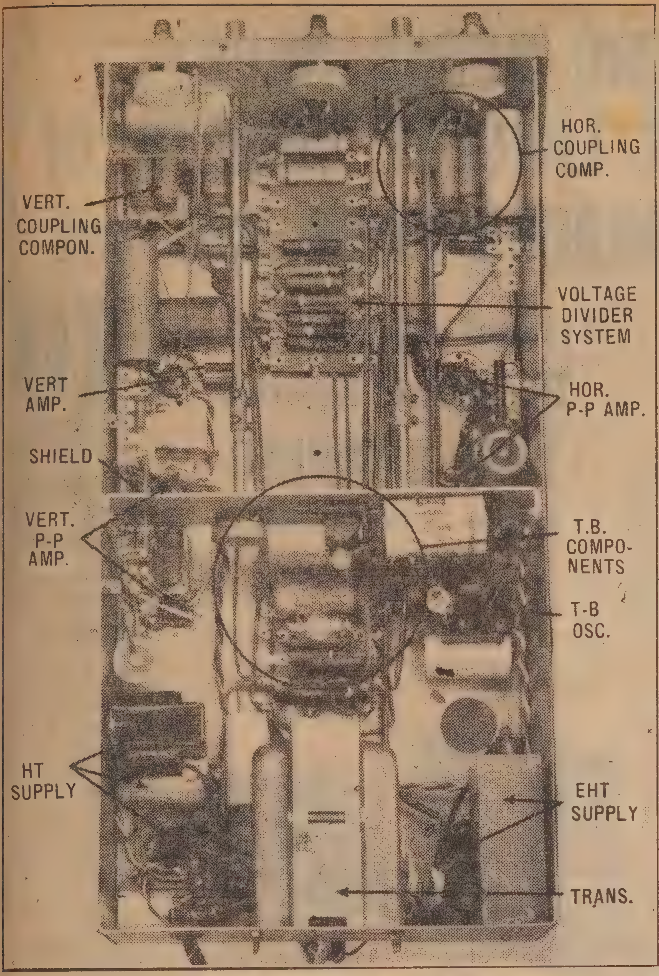

This coded underneath photograph shows broadly how the wiring is arranged.

Beneath that again is another 50-cycle wave (5g) and the sawtooth which produced it from the improved time-base circuitry. The sawtooth wave is slightly better in configuration, but the difference in the pattern is of no great consequence.

The next set of tracings is for a 5000-cycle wave, diagrams (b) and (e) being from the oscilloscope in its original form and (h) and (k) with improved amplifier response. The improvement is becoming noticeable.

The retrace line has a definite lean in (e) but is practically vertical in (k). As a result, the flyback which is apparent in (b) does not appear at all in (h).

Obviously enough, the combination of a "blackout" pulse on the intensity grid of the CRO tube, combined with a very rapid flyback, allows the return trace to be rendered invisible. The scheme doesn't work anything like as well when the return trace is prolonged by restricted high frequency response.

Where the difference does become quite spectacular is in the last group of sketches in figure 6, taken with a signal frequency on the vertical plates of 50Kc.

In the original instrument, amplifier response degraded the time base output at high frequencies to a point where the slope or "rise time" of the retrace was almost the same as the forward trace (f). As a result, the forward pattern (c) is backed by a retrace pattern, which greatly confuses the graph. At still higher frequencies, the position becomes well nigh hopeless.

However, improved amplified response reveals that the output from the time-base is still essentially sawtooth in form (b). (The retrace line behind the sawtooth should, of course, be ignored, since this is produced by a second time-base used to view the one under test.)

Viewed with this improved time-base response, a 50Kc pattern of waves is completely clear and un-

(Continued on Page 113)

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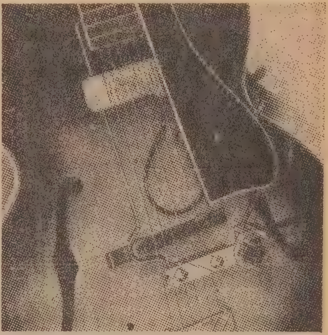

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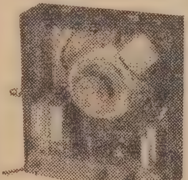

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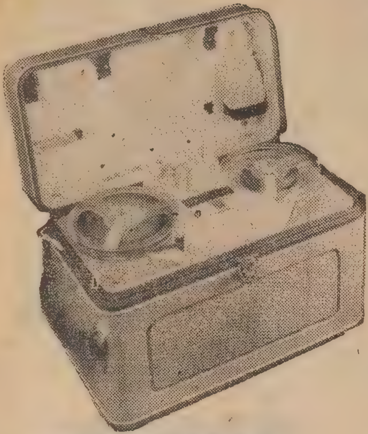

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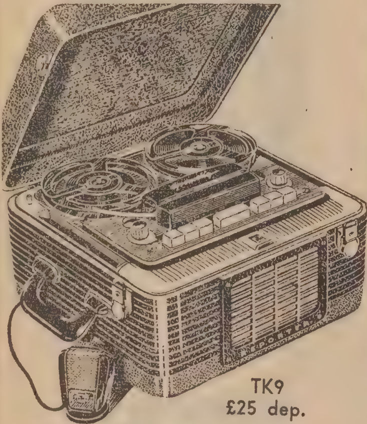

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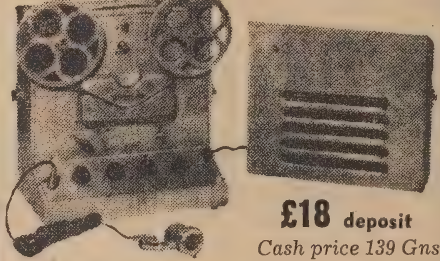

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COMPLETE stranger hailed me the other day with a request to me in and have a look at his set. "I only had it fixed the other day," hissed (almost), "but now the ing's gone wrong again. The dial ing doesn't work and I can't get e stations."

He went on to explain that a fel- w serviceman had charged him r a new speaker, though the set eally didn't need one."

"I don't think he knows anything out radio," he concluded.

On this I couldn't possibly venture n opinion, because he didn't explain ho the other serviceman was. It as quite evident, however, that he ad lost a customer for all time, hether he deserved to or not.

PEAKER REPLACEMENT

I make this last reservation be- ause there may have been a per- ctly valid reason for replacing the peaker. A lot of pre-war units re regarded as obsolete by the anufacturers and cannot be repair- d nowadays when there is any- ing wrong with the cone or voice il.

Then again, a serviceman cannot ways be expected to foresee that a ial cord will break shortly after a t is serviced for another fault al- gether. Things like that do hap- en sometimes.

However, without too many oughts about the "if's" and "buts" f the case, I said I would have a ok at the set.

As it turned out, the dial cord asn't broken at all. Rather did the ial appear to be jammed in some ay or other. Naturally, the set had come out of its cabinet and the ory was laid bare.

The new speaker, which my con- ere had installed, was attached to e chassis by only two bolts near e bottom of the housing. With o other support to hold the speaker rm, the two bolts had loosened and llowed the speaker to sag back- ard under its own weight.

AMMED DRIVE

In so doing, it had jammed against big metal disc which was part f the dial drive. Push the speaker rward, where it was supposed to e and, presto, the dial worked gain!

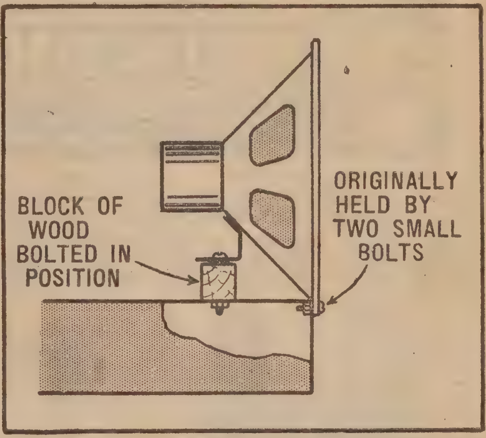
Apparently, our friend had taken look at the steel chassis and forth- ith decided that he was too tired drill holes and make a proper racket. His tiredness — or care- essness — had cost him a customer nd earned him a very vocal critic. uch folk aren't good for any busi- ess.

What did I do? Well, I cut a small ooden block from a scrap of ply- ood, pushed it under the speaker's egular mounting bracket, drilled the ecessary holes and bolted it in place. I was reasonably certain that the speaker wouldn't come loose again.

Now to check the set. It played all the stations to be sure, but, as soon as the gain control was advanced beyond normal room volume, the sound broke up into a series of warbles.

It wasn't RF instability, because there was no sign of whistling and the effect was noticeable only on fairly strong signals. Up to a certain volume, they were quite okay but, beyond that, they dissolved into this rough, warbling effect.

Actually, it took me about two seconds to diagnose the trouble, because I have heard it many times before. Loss of capacitance in the final HT filter capacitor allows audio pulses to feed back along the HT line. They enter screen and plate circuits and, in particular, modulate the output from the set's oscillator.


BLOCK OF WOOD BOLTED IN POSITION
ORIGINALLY HELD BY TWO SMALL BOLTS

What happens when a serviceman doesn't mount a replacement speaker firmly? Answer, it falls backward and jams up the dial mechanism. Cure? Support back of the speaker properly.

Nothing much happens as long as the audio volume is kept low. Turn it up, however, and the set becomes unstable.

What doubtless happens is that a loud, low-frequency pulse from the output stage momentarily affects the high tension voltage. This tends to detune the oscillator so that the signal strength drops. The high tension voltage returns to normal and the process then repeats itself, ad lib, at a random rate.

Hence the "warbling" effect I mentioned, related both to volume and the program being reproduced.

It is, in fact, the same general set of circumstances which produces motor-boating on some shortwave receivers. In this case, of course, something more drastic than just a good HT bypass is required. It is usual to decouple the oscillator supply with a suitable dropping resistor and its own 8 mfd. electro.

Since electrolytics don't dry out overnight, I can only assume that the serviceman who had handled this particular set just previously, either didn't notice the effect or didn't bother to do anything about it.

And, in this case, it happened to be specially important because the owner was plainly very hard of hearing. If anyone needed to play a set consistently at loud volume, he did.

I, therefore, installed a new HT bypass, putting in a 16 mfd for luck. This prevented any possible interaction between the audio system and the tuner section and allowed the set to be turned up to its normal overload point.

Needless to say, I was careful to explain to the owner why I had put in the extra component, otherwise I, too, might have suffered by the remark, "The set really didn't need it." You can't be too careful!

As if to emphasise the point of the story, I had to deal with another rather similar case a few hours afterward.

A nearby resident had taken his portable in to a city store to have new batteries fitted (serves him right). On reaching home, however, he noticed that the set would only tune over about half the dial.

TANGLED WIRES

Thinking that something else had gone wrong and not wanting to fiddle about with the "innards", he brought the set along to me.

You've guessed it! Whoever had installed the new batteries had stuffed the connecting wires in any-old-how and got them tangled up with the tuning gang. It was only neces-

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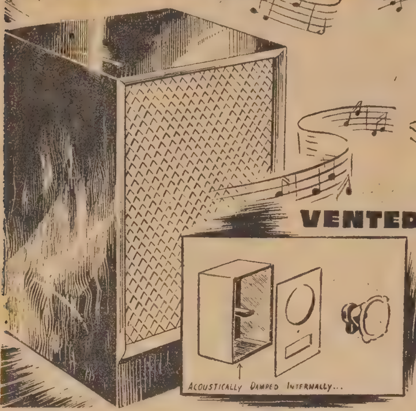
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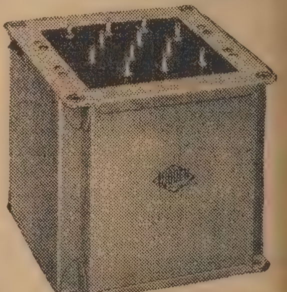

WODEN UM3 TRANSFORMER

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ry to ease the batteries out, tuck
e wires down alongside them, and
was well.

I'm quite certain that my stocks
ent up, while those of a certain
y store went down—which is all to
e good from my point of view!

Not that I'm above doing silly
ings myself, on occasions, as the
llowing rather sorry tale will
ow:

Just before "knock-off" time the
her evening, a young fellow dashed
, looking very agitated, indeed. In
e hand was an electric guitar, in
e other, the amplifier that went
th it. He was due to give a per-
rmance that very evening, he said,
t the thing had "suddenly gone
eak".

There wasn't time to take it back
the manufacturers, but perhaps
could help him out?

When coupled up, the guitar cer-
inly was weak. With the gain
ntrol full on, the guitar was only
st audible.

NAP JUDGMENT

All the valves were alight, but I
ticed that the preamplifier was a
ntode. Looking very wise, I
ined that the trouble was an open
rcuited screen-feed resistor. This
as sheer "skite" on my part be-
use the young fellow wouldn't
ve known a screen resistor from
strawberry blonde!

On second thoughts, perhaps he
ight have.

However, with a flourish, I whip-
d off the knobs and the rear lid,
did the holding-down screws and
moved the chassis.

The only trouble was that the
ntode screen had normal volts ap-
ied. So had the plate and so had
e cathode—just as normal as could

Heck! There must be something
se wrong.

Duly humbled, I began to probe
ound the amplifier's unfamiliar in-
rds and finally came across a grid
hich showed a slight positive volt-
ge. No, it wasn't a phase splitter
cause I could see the grid resistor
nning back to earth.

Must be a leaky coupling capaci-
r!

I, therefore, unsoldered the grid
d of the capacitor. Then, with
e amplifier switched on again I set
e multimeter to the 250-volt range
d connected it from the free end
the capacitor to earth.

O LEAKS

With a leaky capacitor, the meter
ould read a definite positive volt-
ge—a much more effective check
an is possible, by just using the
w volts incorporated in the multi-
eter's "Ohms" range.

But alas. The meter merely kick-
up as the capacitor charged, then
ll back to zero reading. Not a
gn of a leak.

So I checked the grid again, and,
re enough, the positive voltage
as still there.

I could have gone on and checked
e grid resistor for continuity, but,
y this time, I had awakened to an
wful possibility. Perhaps it was a
ulty valve—either one with lots of
as current or with a partial short
etween grid and plate, or grid and
athode.

Since I happened to have a re-
lacement on the shelf, I slipped it
to the socket, re-connected the
rid capacitor and switched on. Up came the gain, up came the volume and down went my ego!

If I'd only had the sense to check the valves in the first place instead of jumping to hasty conclusions, I could have saved myself a deal of work.

Even then, the episode had another reel to run. Having replaced the amplifier in its cabinet, I went to try the guitar again, only to find that the plug wouldn't fit properly. I had to loosen the screws and jockey things around to get the holes in chassis and cabinet to coincide.

But, alas, the plug didn't seem to be making proper contact. "Oh, yes," said the owner, who was still standing by, "you often have to jam a piece of paper in . . . like this".

Since "this" didn't seem to be a very satisfactory way to leave things, I had to pull the whole outfit to pieces again to examine the input socket.

In point of fact, it wasn't a faulty contact at all, but an uncovered pigtail from a nearby capacitor, that was just brushing up against the live connection to the plug, thereby effectively shorting it to earth. I might easily have missed it and had the amplifier go dead in the middle of the next performance.

By the time I'd fixed that up and enlarged the hole in the cabinet so that the plug would fit properly, I was just in nice time to be home late!

All because of a faulty valve!

ANCIENT SET

Yet another case this month involved a set of rather doubtful origin.

As nearly as I could find out from the owner it was some kind of trade-in "bargain" which had been re-conditioned for him by a friend. He had had it about a year, and it had performed quite well until recently when it began crackling intermittently and then refused to play stations at the high frequency end of the band, particularly 2SM and all points above.

The set was a console type, rather larger than usual, and the valve line-up seemed to reflect an "odds and ends" approach to the reconditioning. The converter was an ECH35 and the IF amplifier a 6G8 with the diodes serving for detection and AVC. The first audio stage was a 6J7, and this was followed by a metal 6N7 twin triode in some form of phase inverter driving a pair of 6V6's in the output stage.

When first switched on there was some sign of the crackling, but this cleared quickly, and before I could find out much about it, except that it was ahead of the volume control. I decided to let this fault rest for the time being, and concentrate on the refusal to play 2SM.

LOW GRID CURRENT

Fortunately, the oscillator grid resistor was easy to get at and I connected a milliamp meter in circuit to check the grid current. This turned out to be very low, only 50 microamps instead of the more usual 300 or more.

Number one suspect was the ECH35, but this tested good and a known good one, which I substituted as a double check, gave the same grid current. I was about to start checking other components in the oscillator cricuit when the crackling commenced again.

It rapidly became worse, and I was endeavoring to ascertain the stage involved (with a strong suspicion that it was also in the converter) when the fault solved itself by failing completely. The crackling ceased, the set went dead, and I soon discovered that there was no voltage on the oscillator plate.

The oscillator coil primary had failed and at least I could be thankful that it had not led me the merry dance which I recently described in relation to a similar fault. It also seemed reasonably certain that the faulty oscillator coil had been the cause of the low grid current and poor oscillator performance. It only needed a new oscillator coil to cure both faults

STILL LOW

This was duly fitted and it certainly cured the crackles. Unfortunately there was still only 50 microamps grid current and 2SM could still only be received erratically. So there were two separate faults after all, and I still had to find one of them!

The valve and the coil had been eliminated so I checked the oscillator plate voltage. This was normal, and I turned my attention to the minor components. The oscillator grid resistor was easily measured and was close enough to .05 meg. The 50 pf coupling capacitor was most easily checked by replacement, which I did, but the grid current remained stubbornly at its original figure.

I checked the oscillator plate resistor by-pass, also by substitution, and this had no effect either. Checking over the circuit again there didn't seem to be much left to test, and I was feeling a little at a loss.

SOCKET LEAKS

More or less as a last resort I checked the gang earthing wipers for possible poor connections, without result, then the leakage across the gang, using the condenser leakage tester. This also showed nothing.

The last possibility seemed to be leakage across the socket. Again using the condenser tester (for what it was worth) I checked between the appropriate pins of the socket, the valve being removed and the leads

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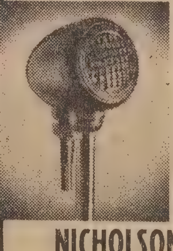
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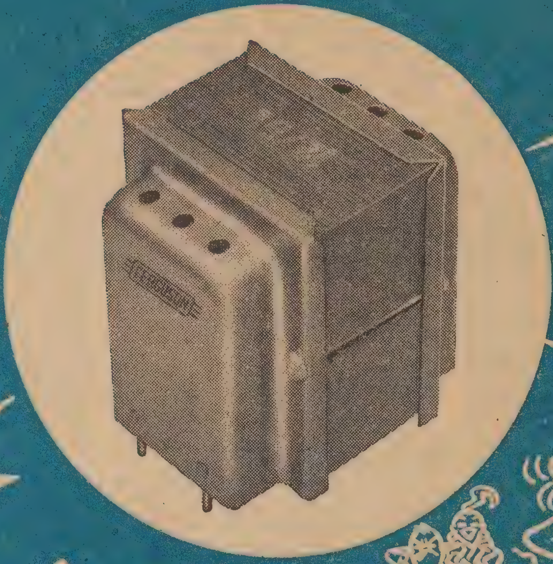

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OP 58	15	10,000, 6,600, 5,000 PP	15, 12.5, 8.4, 6.5 4, 3, 2.7, 2.3, 2
OP 44	10	5,000, 2,500 SE	500, 250, 125
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Engineered TODAY for TOMORROW'S requirements isconnected. Again I drew a blank nd I must confess I felt I had eached the end of my tether.

It seemed that I had checked every omponent in the oscillator circuit, et the thing still refused to oscillate orrectly.

I gave it way for 10 minutes, had cup of tea, pondered on it again ithout getting anywhere, and reurned to the bench.

The set was now sitting right way p and I switched it on and stood taring at it while it warmed up. What on earth could I have overlooked I asked myself and, as if n answer, my gaze fell on the ECH35 ilament. It had been on well over minute now but it was still only very dull red.

Like a drowning man grasping at straw I turned the chassis over nd measured the filament voltage. And there was the story—a fraction ver four volts on a 6.3 volt filament. Modern valves will work over a wide range of voltages, but they ren't that good!

LOW VOLTAGE

Next thing, of course, was to find out why the filament voltage on this valve was low. I soon discovered that all the other valves had similar voltage applied to them, and for a very good reason. The transformer had never been designed to give any other voltage! Yes for some reason or other, the set had been reconditioned but using a four-volt power transformer to operate six-volt valves.

Apparently it had worked too, at least well enough to satisfy a not very critical owner and until the all-important converter valve had lost some of its newness.

The real story behind this "design" I was never able to discover but my guess is that the set had originally used four-volt European valves. When one of these had failed and the owner was faced with replacement problems he had traded it in.

At some stage after this our "resourceful" reconditioner had come into the picture and modified the set to take whatever valves he happened to have on hand. Presumably he adopted an attitude of "anything goes if you can get away with it".

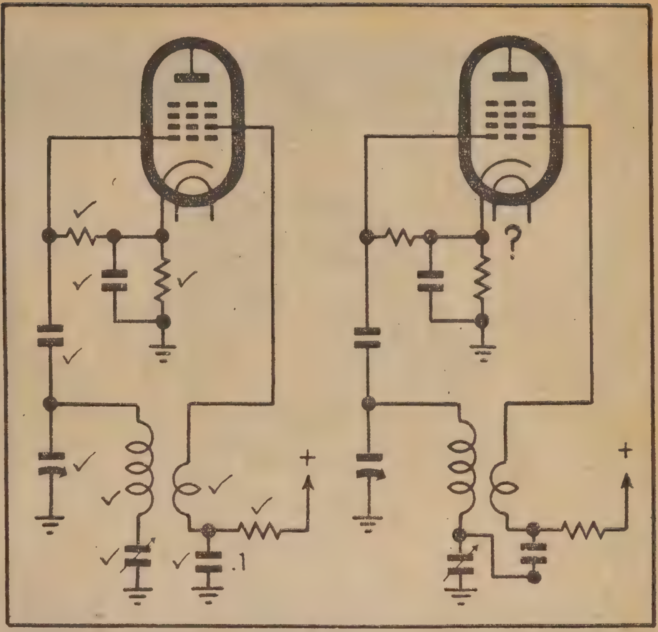
But there was still another problem to be solved. I knew that the present owner was not keen to spend a great deal of money on repairs. He had bought the set cheaply and had intimated when he brought it to me that he didn't consider it was worth a major repair job. I couldn't see him authorising the cost of supplying and fitting a new power transformer.

PADDER FEEDBACK

Then I had a brainwave. What about the old trick of improving oscillator characteristics by means of padder feedback. To try it only involved unhooking the earth end of the bypass on the oscillator plate dropping resistor and swinging it across to the "hot" side of the padder.

It worked like a charm. The oscillator grid current rose to an almost constant 300 microamps over the whole band and the general performance of the converter was improved considerably.

At the same time I didn't feel particularly happy about the scheme. It seemed a "butchery" way of doing things and I would have much preferred to do the job properly.



What can be wrong with an oscillator when you've checked everything and the grid current is still very low? Answer—the heater supply might only be 4.0 volts. "Padder feedback" provided an emergency cure.

When the owner came to collect the set I put the position to him, explaining that the design was fundamentally unsound as it stood and that it should really have a new transformer. At the same time I had been able to improve the performance by a small circuit modification and suggested that this might be sufficient, knowing that he was not keen on an expensive repair.

As I expected, he was quite satisfied to take the cheaper job, reasoning that it still worked good enough for him. Which more or less settled the matter. Unhappy and all as I was with such a rough job, he was the customer and if the customer wants it that way, well . . .

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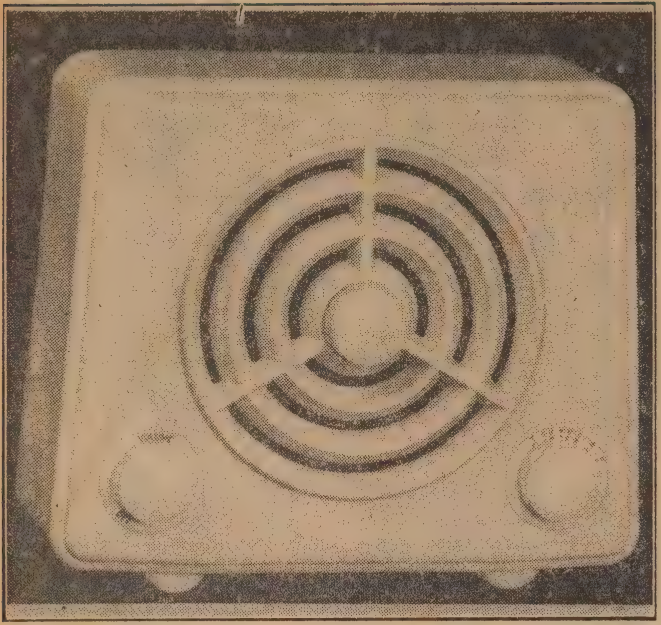
MANTEL MAJOR WITH LOOPSTICK

Our Mantel Major receiver described last month looks as though it will become very popular with our readers, with its handsome cabinet and full-size speaker. This article tells you how the aerial wire can be dispensed with in favor of a modern loopstick aerial.



Front view isn't changed except for the extra knob in the cabinet centre for tone control operation. Cabinet depth actually allows it to be accommodated on even a narrow mantelpiece.

THE Mantel Major, described in last month's issue, was a modern type of mantel receiver built into a plastic cabinet of a design obtainable almost anywhere, and made by Aegis.

This cabinet was intended originally to house an extension loudspeaker for attachment to a radio receiver or sound system and was made large enough to accommodate an 8-inch speaker.

When we first saw this cabinet we were immediately struck with the possibility of using it as the basis of a new mantel set. The cabinet is not a deep one, but there seemed plenty of room to take a chassis with room to spare.

EIGHT INCH SPEAKER

The larger-than-normal front area of the cabinet, and the 8-inch speaker suggested that the tonal quality of the set would be far better than the average mantel, added to which the sensitivity of 8-inch types is generally better than those of smaller diameter.

So we built up the set as visualised, and the Mantel Major was the result.

As anticipated, the performance was first rate. Tried out against several commercial sets, it sounded rounder, fuller, and altogether more impressive on both speech and music. It brought in just about everything to be heard on the air, and measured sensitivity figures on our model were better than those of equivalent commercial sets taken at the same time.

OPERATING KNOBS

We liked the appearance of the set because it is unostentatious and "different". It can sit on any table or mantelpiece and fit into its surroundings. It is handy, neat, and thoroughly practical.

Part of the styling depends on the two large knobs which operate the tuning and volume controls. There is no tuning dial as such. Not only would it have been difficult to fit one into the available space, but the cos would have been increased by a least 20/- without much benefit.

In case you might imagine that direct drive to the gang condense by a tuning knob will make tunin too difficult, we tried it out on number of people before settling o the idea, including some housewive who, with the deepest respect, can not be classed as expert dial twiddlers.

None of them had the slightes difficulty in tuning the stations the wanted quickly and easily. There i a definite attraction in being able t swing quickly over the broadcas band with a flick of the wrist, a against winding a small knob to ru from one end of the band to th other.

The knobs, of course, are not th ordinary type — they have diameter of 1½ inches which is pretty sizeable grip for anybody.

TRANSFER SCALES

The makers of the cabinet have produced transfers with black lettering on a gold background which may be easily deposited on the cabinet front to mark out the stations. A touch of gold paint, or even ink, in one of the knob flutes acts as a pointer, and may be added after the set is lined up and ready to go. Different transfers are being produced for the main capital cities, and, if demand warrants it, a separate scale marked in kilocycles for use where the others are not applicable.

If you are mildly artistic, of course, there is nothing to prevent you drawing out your own scales in any way you wish, and attaching them to the cabinet under the control knobs. But the transfers look very good.

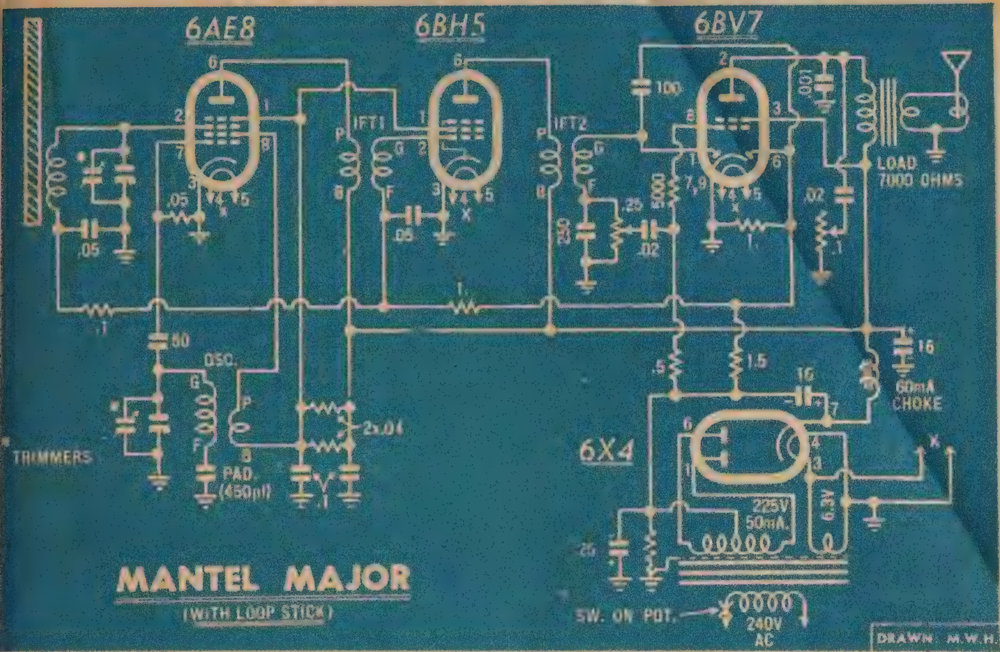
So much for a general description of the set. It is not necessary to say more here, as the details were dealt with fairly fully last month, with a full wiring diagram included and several photographs.

The main purpose of this article is to consider some modifications which can be used in cases where they are applicable, but none of them affects the general nature of the receiver.

The loopstick is a form of inbuilt aerial which allows the set to operate without any external aerial connections. It takes the place of the loop aerial which has been and still is used, but has the great advantage of easy installation and very good effiency.

One major requirement of any inbuilt aerial is that it should not be mounted too near metal objects which reduce its pick-up. Unfortunately this is often unavoidable in a portable set, where space is at a premium, or

CIRCUIT SHOWS ADDITIONS TO ORIGINAL HOOK-UP



The loopstick takes the place of the original aerial coil and connections made to it which in the original were made to the secondary. Additions for tone control are also shown.

a small mantel set for the same eason.

In these circumstances, we have do the best we can and leave at that.

But practically every such set will o very much better if the loop could e removed from the cabinet and ounted in the clear.

OOM FOR LOOP

There is plenty of room with the Mantel Major to mount quite a large oop aerial at the rear, but it would ook rather unsightly unless we fited a back to the cabinet to support he loop.

This wouldn't be very hard to do, s a matter of fact. A piece of plywood fashioned to slip inside the hape of the cabinet and painted vouldn't take long to prepare, and ome counter-sunk screws of light gauge could be run through the abinet. A touch of white paint would nake them almost invisible.

This is something which you might are to do in any case if the open back worries you. A couple of slots cut in the wood, one at the top and one at the bottom, would provide adequate ventilation.

STICK V LOOP

However we have elected to use a loopstick because it is so easy to mount, and equally easy to adjust when in its operating position.

The performance of the stick as against the average commercially made loop is rather better, and in any case is quite adequate for all normal purposes. If we were to hand-make the largest possible loop which would fit the cabinet our results might be a fraction better, but such loops call for individual adjustment and requires quite a bit of patience and trouble to make and fit.

Loopsticks aren't very expensive, and score heavily on the grounds of convenience.

If you glance at the rear view of the set you will see that the stick is mounted at the top of the cabinet where it is virtually in the clear. This allows maxium pick-up and accessibility.

Some loopsticks are already fitted with mounting brackets. These are made of aluminium, and are fitted with large rubber grommets into which the ends of the stick are pressed for support. If yours should be minus these brackets, they can be made quite easily.

We used two of the bolts which fasten the speaker in the cabinet to hold a couple of extra brackets which

PARTS LIST

1 Chassis 11¼" x 3¾ x 1"
1 Power transformer 220V at 50mA. 6.3V at 2A.
1 Filter choke 60mA
1 2-section gang MSP.
2 4-70pf trimmers.
1 loopstick type aerial.
1 Coil Kit, miniature oscillator coil, 2 IF's at 455Kc.
1 8 inch speaker with 7000 ohm transformer.

SOCKETS

3 Novals, 1 7-Pin miniature.

VALVES

1 6AE8. 1 6BH5. 1 6BV7. 1 6X4:

CAPACITORS

2 16 mfd 350 PV electrolytics. 1 25 mfd 40PV electrolytic (optional) 2 .1 mfds, 2 .05 mfds, 2 .02 mfds, all tubulars not lower than 300 volt rating.
1 .001 mfd, 1 450 pf 2½ pc padder, 1 250 pf, 1 100 pf, 1 50 pf, all mica.

RESISTORS

1 1.5 meg, 2 1 meg, 1 .5 meg, 1 .1 meg, 1 .05 meg, 1 5000 ohm, all ½W.
2 .04 meg 1W, 1 100 ohm 1W: 1 .25 meg. potentiometer with switch.
1 .1 meg potentiometer.

SUNDRIES

3 1½in knobs with special scales (see text).
3 core power flex and plug. 1 terminal. 1 7 terminal tag strip,
3 5 terminal tag strips. 1 7/16in grommet. 2 3/8in grommets. 2 1¼in grommets. 3 ¾in by 3/32in CSK Hd screws. Scrap aluminium for mounting plate. Hookup wire, nuts and bolts, solder lugs, solder &c.

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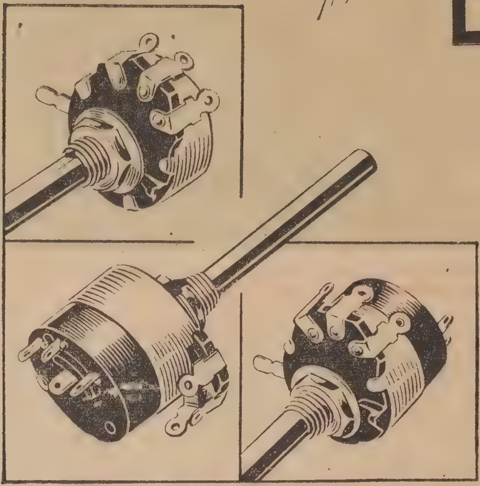

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e bolted to those already fitted the stick. Our new set of brackets e simply two right angled strips metal — we used aluminium scraps which we bent up in the vice and illed in about five minutes.

Their precise form and shape isn't all important, and it would be ite possible to fabricate a single it for each end of the stick if you e very fussy. We advise the use the gommets to hold the stick place. The only other requirement that it should be in the clear and near the top of the cabinet as posle.

When using the loopstick, it takes e place of the aerial coil of the t, so if you intend to use it from e start, you need not buy the rial coil at all.

In our case we merely disconnect the grid and AVC connections from e coil and wired the stick to these ints with ordinary hook-up wire isted loosely together for a neat b.

ONNECTIONS

The grid connection can be made rectly to the top of the aerial secon of the gang and the AVC conction run through a hole in the assis to the tag strip holding the VC resistor and decoupling connser.

The coil on the stick thus directly places the secondary of the aerial il.

The cost of the loopstick is somehat offset by the absence of the rial coil originally used.

The stick is lined up quite simply. ormally the coil will be mounted ar one end, and for lining up purses the stick itself can be considered the iron core of the normal coil.

The gang trimmer will operate as efore, and is adjusted to peak at e high frequency end of the tung range.

At the low frequency end of the ange, the set is lined by moving e coil on the stick until the signals e heard with greatest volume. The il is wound on a former which is close fit to the stick, and which ill slide along it without much ffort.

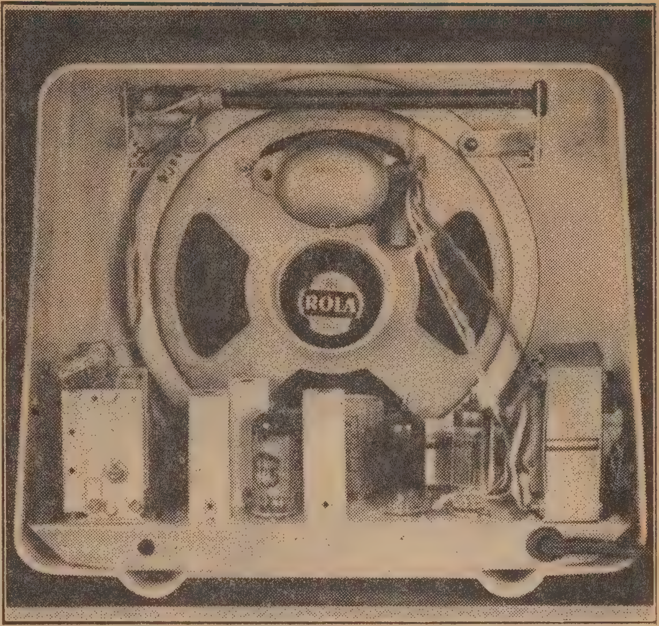
Having adjusted the coil position, o back to the high frequency end of e dial and check the trimmer setng, the adjustment of which will robably have altered slightly. A econd check on the coil position hile tuned to the low frequency nd will bring you to just about the ptimum setting. Backward and orward once or twice with these adustments will give you the most acurate peak.

ONE CONTROL

The other modification is the fiting of a tone control. Whatever the urist may have to say about these evices there is no doubt that most sers demand them. In the case of mantel set, where the response is imited anyway, it is hard to make case against some means of modiying, to suit individual tastes. It is lso handy when battling against xcessive noise level in one form or nother.

Electrically the control is quite imple, consisting of a .02 mfd apacitor and a .1 meg. potentiometer in series, the combination onnecting between the output plate and chassis. The values are not parVicularly critical and the capacitor an be made larger or smaller if the ffect is not exactly to your liking. In general, however, the specified value should be quite suitable.

SHOWING MOUNTING OF STICK



This picture shows how the loopstick is mounted by two metal brackets fastened under the same bolts which hold down the loudspeaker. They are easily bent up from scrap.

Mechanically the arrangement is rather unusual, though it does not present any great difficulties.

Since there is not a great deal of space available where the extra control may be mounted logically we have placed it in the centre of the speaker grill. We cannot claim this as an original idea, since some versions of this cabinet have been made to take a control in this position, it being originally intended as auxiliary volume control when used as an extension speaker.

While the cabinets normally available for this set will not have this feature (it could prove an objectiion if no tone control was contemplated) it is quite easy to modify a plain cabinet to suit.

Commence by drilling a 5/16in hole in the exact centre of the speaker grill. This is slightly larger than the ¼in shaft to go through it and provides a small margin for mounting errors. The plastic material is not difficult to drill and there is little risk of damaging the cabinet if ordinary care is exercised.

The control is mounted on a small metal plate held against the inside of the speaker grill by means of three screws. The plate we used was circular and about 1½in in diameter, though there would be plenty of room for a larger plate or a square one with 1½in sides. In the centre is a 3/8in hole to take the control.

Each of the three screws to hold the plate passes through one of the three radial channels forming part of the speaker grill. In our case the holes were ½in from the centre of the grill, though the distance is not critical. While it might be possible to use standard 1/8in screws, a smaller size is to be preferred and we used 3/32 Whitworth. Three-quarters of an inch should be long enough and a countersunk head is best, though not essential.

If the corresponding holes in the plate can be tapped to suit the screws it will make the assembly much easier, but clearance holes and nuts can be used if necessary. In any case it will probably help if the control is spaced away from the mounting plate with two or three metal

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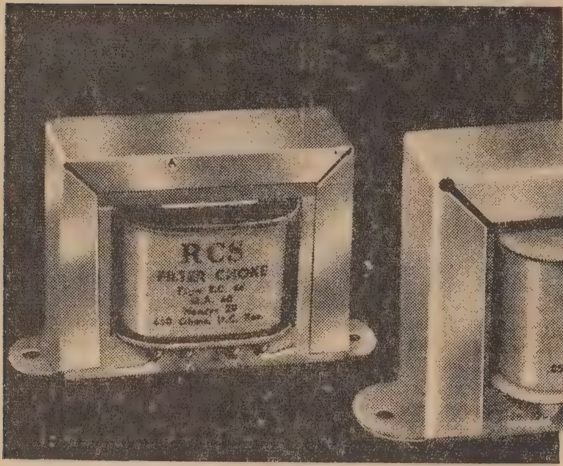

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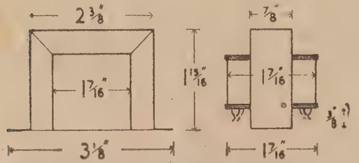

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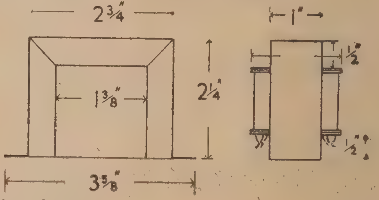

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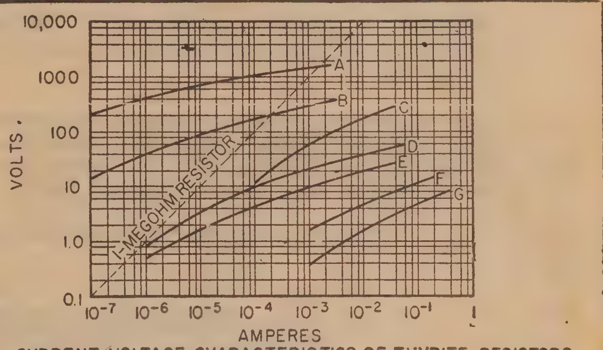
NON-LINEAR RESISTOR THEORY

Not all resistors obey Ohm's law—or so it might appear. Some show a marked tendency to change their DC resistance according to the amount of current flowing through them. Such non-linear properties, which provide the basis of the familiar current regulating devices, are finding increasing use overseas in a wide variety of applications.

A FEW quite familiar electrical devices are distinguished by heir non-linear current v. voltge characteristics of a magniude sufficiently great to affect erformance. Often this phenomenon is a characteristic.

For example, non-linearity is oberved in the plate characteristic of a acuum tube under certain operating onditions; at the extremity of a diode ube response curve; in iron-cored inuctors operated in the region of aturation; in biased capacitors havng special ceramic dielectrics (dielectric amplifiers).

These are only a few examples. The non-linearity of certain 2-terminal devices such as a resistor also may be employed to modify the operting characteristics of some circuits. These latter non-linear resistors do ot obey the simple relationship, R quals E/I, of Ohm's Law.



CURRENT-VOLTAGE CHARACTERISTICS OF THYRITE RESISTORS

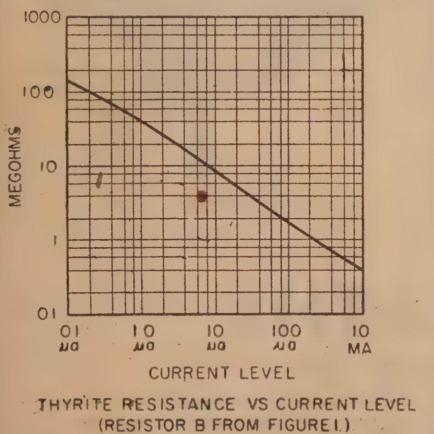
FIGURE 1

THEIR USE

Simple non-linear resistors are used n oscillators, wave shaping networks, voltage regulators, current regulaors, constant-output potentiometers nd voltage dividers, voltage-selective ircuits, amplitude limiters, frequency multipliers, surge suppressors, &c.

Their use in electronics is increasng as new requirements for non-inear current - voltage response arise.

This article describes the general characteristics of some common 2-erminal non-linear resistors of several classes. In some instances, as will be seen, these devices have other prime uses and their application as non-linear resistors is secondary. Typical applications will be shown



THYRITE RESISTANCE VS CURRENT LEVEL (RESISTOR B FROM FIGURE 1.)

FIGURE 2

Thyrite resistors were introduced by General Electric Company and were applied in the electric power field some number of years before entering electronics.

Thyrite resistors are made of silicon carbide, bound with a filler, then pressed and fired at high temperature. They are fabricated in the form of pigtailed rods (identical to "radio resistors"), discs, washers, and stacks. Small units suitable for electronic applications are supplied up to 10 watts power rating (continuous).

The non-linearity of the thyrite resistor is expressed by I equals k times E to the power n, where I is the instantaneous alternating or direct current (amperes), E the instantaneous applied voltage, k a constant (amperes at 1 volt), and n an exponent between 3.5 and 7 governed by the manufacturing process.

Figure 1 shows a set of typical thyrite current-voltage curves for several types of GE thyrite resistors. The curve for a conventional 1-megohm linear resistor is plotted for comparison. From these curves, it may be seen that large current changes result from small applied - voltage changes.

Figure 2 is a plot of resistance v. current for resistor B from Figure 1. Note in Figure 2 that a change of 10,000 to 1 in current flowing through this resistor changes the resistance of the latter by approximately 375 to 1.

Thyrite resistors have the advantage of operating in both AC and DC circuits. Any rectification effects are negligible. (Figure 3 shows a typical static positive-negative conduction curve.)

High-frequency AC operation of thyrite is possible, the limiting factor appearing to be capacitance. It should be noted, however, that in AC operation the non-linearity of the thyrite volt-ampere characteristic causes distortion of the current waveform.

Figure 4 shows the distorted current wave accompanying a sine wave of applied voltage. Observe that odd-ordered harmonics are prevalent. This phenomenon is utilised in simple frequency multipliers and harmonic accentuators.

The temperature coefficient of thyrite resistance is negative in sign and varies from minus 0.4 to minus 0.73 per cent per degree Centigrade in the range 0 degree C. to 100 degrees C.

Figure 5 shows several typical circuits utilising the properties of thyrite resistors.

TYPICAL CURVES

Figure 5 (A) is a simple voltage regulator or compressor for smoothing variations in supply voltage. The fluctuating input voltage produces fluctuating current which flows through the thyrite resistor (T) and a linear limiting resistor (R) in series.

Fluctuations in the resulting voltage drop across the thyrite resistor are considerably lower in amplitude than those in the supply voltage, due to the non-linear E/I relationship in the thyrite.

It should be noted that a voltage reduction unavoidably occurs be-

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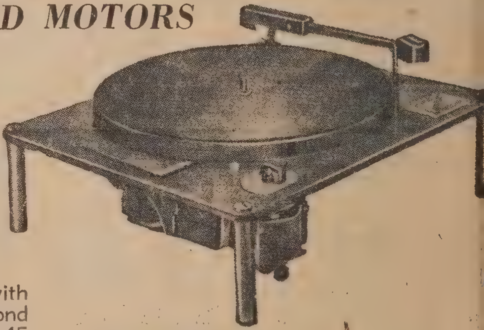

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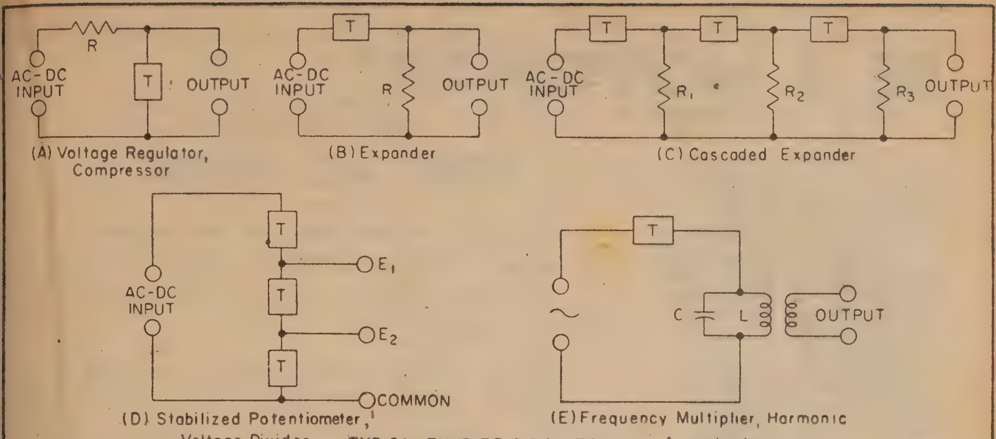


(A) Voltage Regulator, Compressor (B) Expander (C) Cascaded Expander

(D) Stabilized Potentiometer, Voltage Divider (E) Frequency Multiplier, Harmonic Accentuator

TYPICAL THYRITE CIRCUITS

FIGURE 5

cause of potentiometer action between R and T.

In the expander circuit in Figure 5 (B), the opposite action is secured. Small fluctuations in applied voltage produce large fluctuations in current through thyrite resistor T. These current fluctuations in turn produce a fluctuating output-voltage drop across R.

Since the resistance of R must be small with respect to that of T, voltage divider action between the thyrite and linear resistance legs of the circuit produces a drop in voltage level.

Several TR sections may be cascaded, as shown in Figure 5 (C), to secure additional expander action, at the expense, of course, of further voltage division in each section.

Figure 5 (D) shows a potentiometer or voltage divider with thyrite sections. The non-linear E/I characteristic of the thyrite sections yields a nearly constant output voltage at each tap, although supply and load currents are variable.

For efficient operation of the circuits shown in Figures 5 (A) and (D), the thyrite current must be high in respect to the output load current. In Figures 5 (B) and (C), current in resistor R must be high with respect to output load current.

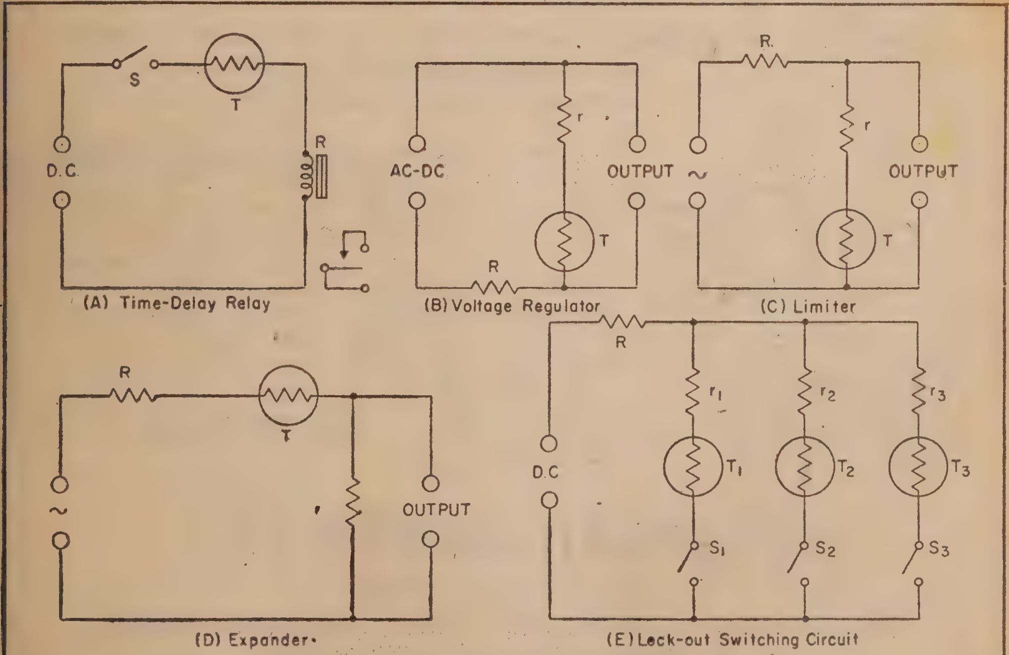
Figure 5 (E) shows how a thyrite resistor can be connected into a circuit to accentuate harmonics and act as a simple frequency multiplier. Alternating current is fed into the circuit and undergoes distortion in passing through the thyrite.

The tuned circuit, LC, is adjusted to the desired multiple frequency.

It has been shown already in Figure 4 that odd harmonics are favored by this type of operation. The thyrite frequency multiplier thus is most practical for tripling, quintupling, &c.

The thyrite resistor is a dissipative element, however, and its insertion into a circuit in the manner shown in Figure 5 (E) results in some power loss. In applications where a considerable amount of power is available, the relative simplicity of the thyrite frequency multiplier can offset its unavoidable power absorption

The thermistor, a product of research by Bell Telephone Laboratories and manufactured by Western Electric Company, is another interesting non-linear resistance device.



(A) Time-Delay Relay (B) Voltage Regulator (C) Limiter

(D) Expander (E) Lock-out Switching Circuit

TYPICAL THERMISTOR CIRCUITS

FIGURE 8

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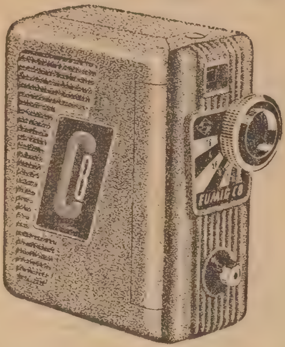

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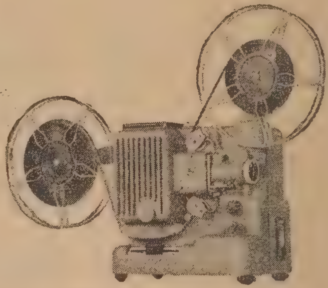

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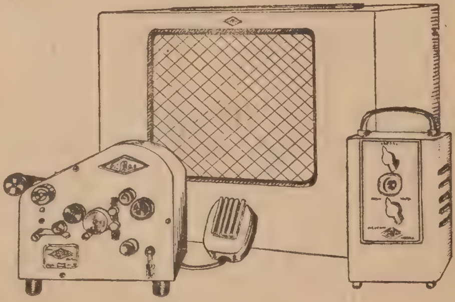

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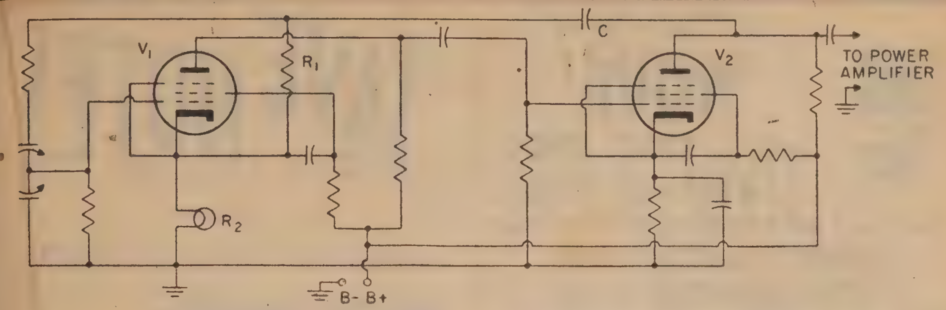


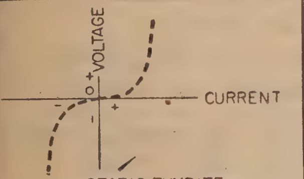
TUNGSTEN LAMP (R2) AS STABILIZING RESISTOR IN AUDIO OSCILLATOR

FIGURE 9

Its action results from internal heating effects in special materials.

Thermistors basically are thermally-sensitive resistance devices. They are manufactured in the shape of rods, discs, beads, wafers, and flakes, and are made of various semiconductor materials. Like thyrite, the thermistor can be used with either AC or DC.

Figures 6 and 7 show two important response curves describing thermistor action. From Figure 6, it is seen that the voltage drop across the thermistor increases non-linearly and rapidly with current flow up to a point beyond which the rate of increase falls. Finally, a peak is reached and beyond this latter point the voltage drop decreases with increasing current, displaying negative resistance.



STATIC THYRITE CONDUCTION CHARACTERISTIC

FIGURE 3

An interesting side observation is that this negative-resistance property has been utilised to obtain low-frequency tubeless oscillation and amplification with thermistors.

In Figure 7, the plot shows how at a particular applied voltage internal heating causes the magnitude of thermistor current to vary as a function of time. This property has been utilised in various simple time-delay devices.

Figure 8 shows several simple circuits employing thermistors. In all except Figure 8 (A), a small current-limiting resistor, r, is indicated.

THERMISTORS

Figure 8 (A) is a time-delay DC relay based upon the action illustrated by the curve in Figure 7.

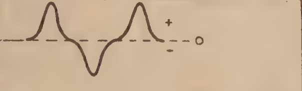
Some seconds after the switch, S, is closed, the circuit current rises to a value high enough to close the relay. The delay interval depends upon thermistor characteristics and supply voltage level, and can be adjusted to some extent by means of linear series resistance.

Figure 8 (B) is the circuit of a regulator for supply-voltage variations and is somewhat similar to the thyrite voltage regulator. Its operation is based upon the non-linearity of the thermistor which results in smaller variations in thermistor voltage drop than the fluctuations occurring in supply voltage and current.

Action of the limiter circuit, shown in Figure 8 (C) is similar to that of the voltage regulator, amplitude excursions in the input signal being reduced in the output without clipping or slicing action.

Operation of the thermistor expander circuit, Figure 8 (D), is the opposite of that of the limiter. The thermistor and load resistor are interchanged in position, output being taken across the resistor. A small signal-voltage change produces a large thermistor current change and a large voltage change across the output resistor.

A voltage division takes place in the circuits shown in Figures 8 (B), (C), and (D), as the result of potentiometer action between the thermistor and the linear series resistor.



A C DISTORTION DUE TO THYRITE

FIGURE 4

Because of this action, the absolute level of the applied voltage is reduced in the output.

Figure 8 (E) shows a lockout-type switching circuit employing thermistors. In each leg of the circuit, r is a load resistor or represents some device, such as a relay, which is to be actuated by current flowing through the associated thermistor.

The supply voltage and the value of linear series resistor R are chosen so that this resistor will support the current of only one leg before its voltage drop becomes excessive. When one switch (say, S1) is closed, the associated thermistor "breaks down", allowing current to flow through and operate the associated device, r1.

This lowers the voltage at the inside of R, so that no other thermistor can "fire". Only after S1 is opened can either of the other circuit legs be operated. Operation of any one thermistor leg thus locks out all of the other legs.

An arrangement of this type would enable a number of devices having similar volt-ampere characteristics to be connected across a single voltage pair, but with only one device operable at a time.

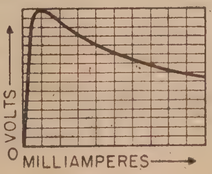
SIMPLE CASE

The tungsten filament incandescent lamp is fairly well known as a non-linear resistor in which current change lags a corresponding change in applied voltage.

Up to the point at which heating effects begin to evidence, the filament volt-ampere characteristic is linear, or very nearly so. The non-linear region of lamp-filament resistance has been utilised in voltage-stabilisation bridges, simple regulators and allied devices.

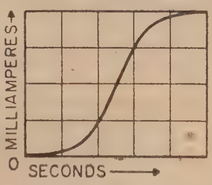
In a common application, the lamp-type resistor is used as an automatic regulator of degeneration voltage in low-distortion, RC-tuned oscillators. A typical circuit is shown in Figure 9.

In Figure 9, the lamp (R2) is the cathode resistor of the first pentode, V1. Feedback current from the output of V2 flows through capacitor C



STATIC DC CHARACTERISTIC OF THERMISTOR

FIGURE 6



TIME-DELAY ACTION OF THERMISTOR

FIGURE 7

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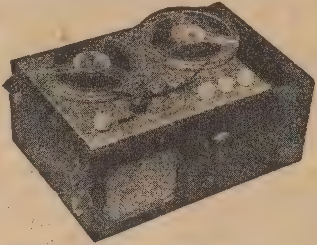

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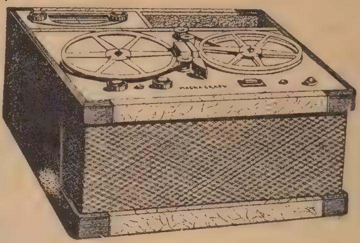

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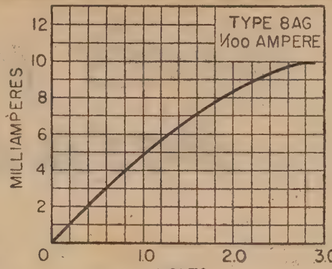
to the frequency-selective RC network in the grid circuit of V1. A portion of this current also flows through resistor R1 and the lamp R2, establishing a negative feedback voltage across the latter.

The lamp resistance is low when the feedback current is small, and is high when this current is large. Thus: Strong oscillations result in large amounts of inverse feedback voltage across R2, and this degeneration in turn reduces the amplitude.

The opposite also is true; at weak oscillation amplitudes, there are lesser amounts of degeneration, and gain through the two-tube circuit automatically rises. The net result is uniform amplitude of oscillation.

Thermistors also are used occasionally in some RC-tuned oscillator circuits to stabilise oscillation amplitude.

Small frequency, low-current fuses exhibit a type of non-linearity somewhat similar to that of the tungsten filament. Figure 10 shows the static DC volt-ampere characteristic of a sample Type 8AG 10-milliampere Littelfuse. In this instance, response is linear from zero up to the 0.8v., 4ma. point. Beyond this, the non-linearity is apparent.



STATIC D.C. CHARACTERISTIC OF MINIATURE FUSE

FIGURE 10

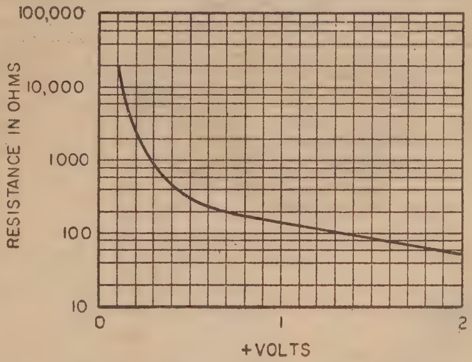
FUSES

When DC biased to a point within the square-law region of their non-linearity, such fuses often are used as bolometer-type detectors in microwave work. This provides an extremely simple and inexpensive demodulator at frequencies up to many hundreds of megacycles.

Non-linearity in the forward conduction characteristic of the germanium diode suits this simple component to use as a non-linear resistor in applications within its current capabilities.

While the reverse - conduction (back-current) characteristic of the diode also is non-linear, it does not in general offer the same possibilities of application that are available with the front conduction.

Figure 11 shows a plot of forward resistance vs applied voltage for a high-conduction-type germanium diode. Here, the polarity of the applied voltage is such that the anode of the diode is positive. Diodes may be connected in series, parallel, series-parallel, and parallel-series to obtain many attractive non-linear resistance effects.



STATIC FORWARD RESISTANCE OF GERMANIUM DIODE

FIGURE 11

Various portions of the forward volt-ampere characteristic of the germanium diode exhibit square law, logarithmic, and finally approximately linear relationships between E and I. By operating the diode in a desired one of these regions, the particular corresponding portion of the curve can be utilised to correct or modify the E/I characteristic of another circuit.

FORWARD RESISTANCE

For example, a linear microammeter may be converted into a square-law instrument by using the forward resistance of the diode as the meter series resistance (multiplier).

Diodes suffer somewhat in comparison with other 2-terminal non-linear resistors because the diode is a rectifier. This limits application in some cases to direct-current use only. However, small AC signals may be superimposed upon a DC forward bias current applied to the diode, the two currents being so proportioned that the net diode voltage never becomes a zero or negative.

Diodes also are relatively low current devices, as compared with some other non-linear resistors.

Like the thyrite resistor, the forward-conducting diode is capable of distorting an AC current waveform and occasionally is used to accentuate harmonics. The requirement is that the diode current magnitude be such as to operate the diode in its most non-linear region.

Thus, the simple series connection of a diode in the plate or grid lead of an oscillator or amplifier can accentuate harmonic content of the current waveform when this type of operation is required.

An example is the distortion of waveform of a standard-frequency oscillator to produce high-order harmonics for calibration purposes.

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WORLD'S NEWS—Every Monday—6d

Here's your answer, Tom!

This month Tom has again come forward with a motley assortment of questions. He is apparently having trouble fitting the radio to his new car. That is one problem. Then, while delving into the innards of the set some unusual things caught his eye.

CARS are expensive enough these days even without radio, Tom, and if you have an old set on hand put it into the new car by all means. It's worth a trial anyway, as long as you don't have to deface the car!

I have a 6-volt radio which I now wish to instal in a car with a 12-volt electrical system. Could I have the radio altered to operate from 12 volts or do you advise me to simply connect it across half of the present battery?

"If you have an old set . . ."

Many thanks indeed, Tom, for bringing up the question. There has been a great amount of interest in this subject recently, due to the increasing popularity of 12-volt systems.

Perhaps the most obvious course is to send the set back to the manufacturer with a request to change it over. Most sets are available in either 6 or 12 volt models and, provided your set is not a 1927 model or thereabouts, the parts of the alternative voltage should be fairly easily obtainable. In most cases the overall cost of the changeover would be only a fraction of the cost of a new receiver.

There are a few receivers where a change would be difficult and impractical, in which case you have either to trade it in on another receiver or consider one of the methods we will discuss later.

If the manufacturer is not prepared to do the job for you himself, he may be prepared to supply the parts so that you can do the job yourself. You will probably need only a power transformer and vibrator. The present 6-volt series of valves need not be replaced by 12-volt types, since it is possible to wire the filaments in a series parallel network to operate from the higher voltage.

It is possible you will need an odd resistor or two to complete the network, but this is a minor matter. Such resistors dissipate relatively little power and are therefore quite a practical proposition. Most 12-volt commercial receivers use 6-volt valves in this way.

The 6-volt receiver could be put into operation very simply by connecting it across half the 12-volt battery, as you suggest. This may be okay as a temporary measure in order to get the set into operation for a special occasion, but we do not recommend it on a permanent basis because one half of the battery will always tend to be undercharged and the other half will always tend to be overcharged, regardless of whether the car uses the old-style "third-brush" system or a modern voltage regulator.

USE OF RESISTOR

The total voltage of the battery will no longer be indicative of its general condition.

Another possibility worth considering is to wire a heavy-duty dropping resistor in series with the set and operate it from the 12-volt supply. This means that the set is taking twice as much power from the battery as is actually being used for its operation.

In the case of a modern car with a well adjusted voltage regulating system this may not be too serious. All it would mean is that the generator has to charge a little harder when the radio is in use.

It is not easy to calculate the correct value of the series resistor because the set does not draw a completely steady current from the supply. Rather, the action of the vibrator is to take a series of pulses of current. For this reason, we would suggest that you connect a voltmeter across the set and gradually reduce the value of the resistor until the meter reads exactly half the supply voltage.

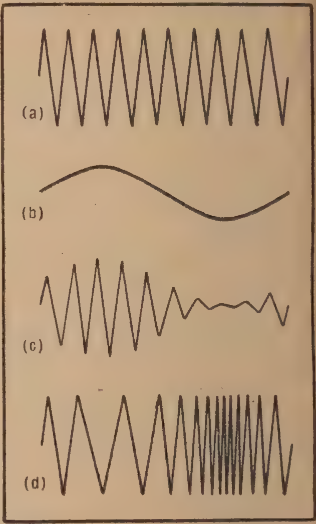
The meter will actually read the average value of the voltage, but this is close enough to the RMS value for this purpose.

The voltage on the filament network will now be correct, but, due to the altered wave shape, you may find that the high-tension voltage is lower than before.

With some sets, too, there is a possibility that the changed connection will introduce hum and hash. A large electrolytic connected across the power leads at the set may help to improve matters.

The approximate value of the dropping resistor can be calculated knowing the current drain of the set. If it takes 3 amps, for example, the resistor will be somewhere about 2 ohms. Start with 2½ ohms in this case and work down to the correct value. A heavy resistor such as this could conveniently be made from fairly heavy gauge resistance wire wound around some insulating material which is able to withstand a good deal of heat.

One argument against the scheme is that the valve filaments are subjected to a considerable overload if the vibrator ceases to function. Provided the overload were not left on too long, the valves would not be damaged, but if a set operated in this way ever stopped, we would recommend that you switch it off quickly.



Illustrating the difference between AM and FM transmission.

Could you tell me if upright electrolytic capacitors with one connection are as efficient as horizontal types with two connections? What is the difference between them?

If you like Tom, there's about as much difference between them as between a motor car and an automobile—as we said about a similar query some years ago!

Electrically they are identical but they do come in many shapes, sizes and colors.

The only difference is in the can, into which the "works" are fitted.

For the upright variety a lug is fixed to the positive terminal, while the connection to the negative side is conveniently made by the clip fitting around the can.

Horizontal or "pigtail" types, on the other hand, have a pigtail attached to both the positive terminal and the bottom of the can. The whole assembly is then slipped into a cardboard cylinder for convenient under-chassis use.

Whether you choose one type or another, then, depend entirely on the space available and other mechanical considerations.

CONDENSER MOUNTING

Due to their bulk, electrolytic capacitors cannot always be safely "hung" in place by their pigtail connections only. It may be all right in ordinary sets but, in the case of mobile equipment where mechanical rigidity is important, upright capacitors are often specified.

It may also be that there just isn't enough room below the chassis to accommodate a bulky capacitor and it has to be mounted above chassis with the connecting lugs protruding to the underside.

Continuing his investigations Tom apparently also had a good look at the valves. We can only hope that he got them back into their sockets in the correct sequence!

I have noticed that in most radio valves there is a small plate near the base of the valve usually attached to the cathode. What is the purpose of this plate?

You certainly don't miss much, Tom, do you? That little plate is an important aid to the manufacture of valves.

During assembly this plate is fixed to the valve structure and a small piece of magnesium or barium attached to it.

The structure is slipped into the glass envelope and fused into position. Then the bulb is evacuated and the pump tube at the bottom finally fused to prevent the entry of air into the valve.

Even with present day machinery it is very hard to remove the last traces of gas from the envelope. Also the metal and mica parts of the structure contain some gas, which is given up when the structure is heated.

As you know, Tom, there is a good reason why radio valves are also called vacuum tubes. Generally the less "atmosphere" there is inside them, the better they work. So some means had to be found to remove this gas still present after the valve has been sealed.

This is where the little metal plate comes into the picture with its attached pellet of magnesium.

During the evacuation and sealing process, a high frequency field is used to head the metal structure inside the valve to red heat, thereby driving out much of the "occluded" gas.

As the evacuation tube collapses and seals off the bulb, the high frequency heating "fires" the pellet of magnesium which evaporates and absorbs most of the remaining gas.

It condenses on the glass envelope which, not being a conductor, is not heated directly by the high frequency field.

The magnesium forms a mirror-like surface on the inside of the bulb and is generally referred to as the "getter".

The little plate, although it takes no further action in the operation of the valve, remains inside the valve because it would be rather awkward to remove it without losing the vacuum!

And while on the subject of car radios, Tom also managed to slip in a question about FM-AM radios.

Looking through a Continental magazine I noticed some manufacturers advertising AM-FM car radios. What do they mean by AM-FM?

There is a lot more behind those letters, Tom, than meets the eye. Those letters designate two different broadcasting systems: Amplitude Modulation and Frequency Modulation. And to understand what they mean we have to go right back to the fundamentals of radio transmission.

If an alternating current of radio frequency is fed to an aerial it will radiate electromagnetic waves into space. A receiver tuned to this frequency will be able to pick up this radiation. But there will be no sound out of the loudspeaker, because the radiation is constant in frequency as well as strength.

If information has to be transmitted, the frequency or the strength of this radiation has to be changed or "modulated", as we term it.

The simplest way would be to interrupt the radiation periodically (i.e. vary its strength from zero to a predetermined level.) This method is extensively used for transmitting Morse code, but is obviously unsuitable for the transmission of speech or music.

AM OR FM

However, receivers can be made to detect periodic variations in either the amplitude (or strength) or the frequency of the radiation. If we vary either of these two in accordance with an audio signal (speech or music), the receiver will reproduce them.

It would be outside the scope of this page to explain in detail how this is done, but the accompanying diagram gives an idea what happens to the radiation.

Incidentally, the radio frequency transmitted by a station is called the "carrier", because it carries the information. If we keep the frequency of the carrier constant, and vary its amplitude or strength, we have an "amplitude modulated" signal.

If we vary the frequency and keep the amplitude constant, we have "frequency modulated" signal.

The difficulty lies in the fact, that a receiver made to respond to amplitude modulated signals (fixed frequency, varying amplitude) is not able to detect a frequency modulated signal (fixed amplitude, varying frequency).

Combination AM-FM sets actually

(Continued on Page 119)

The RADIO MASTER

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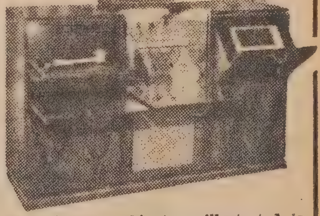

Cocktailgram cabinet as illustrated is 4ft 6in wide and supplied ready to fit your own changer and chassis. Centre section has four pieces of mirror glass (side to side), glass shelf, philenia lamp, automatic switch actuated by opening door and chrome plated accessories. Price: £58 plus £1 for packing, freight extra. Also available without glass to suit tape recorders.

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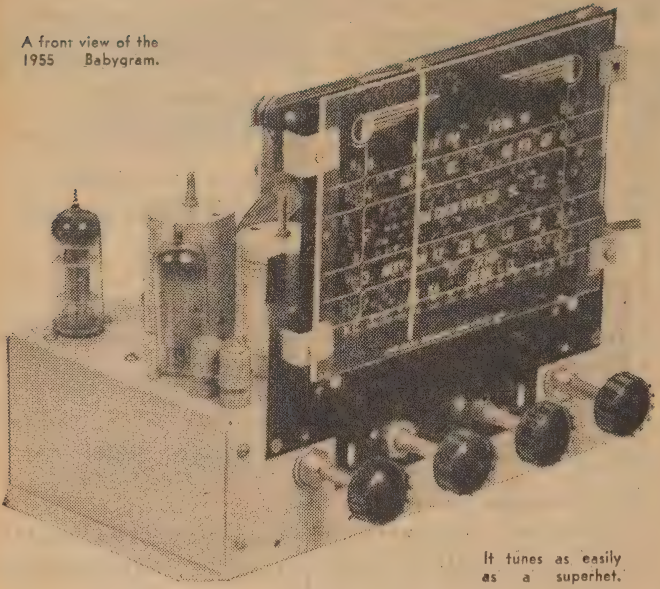
by

L. Varady



A front view of the 1955 Babygram.

It tunes as easily as a superhet.

THREE-SPEED record players enjoy a tremendous popularity these days and many a father has yielded to the persistent demands of the younger generation to install such a new-fangled contraption in the family radiogram. And the single-speed player duly takes its place in the attic, next to grandpa's phonograph and Dad's early attempts at radio from the "cat's whisker" days.

Ever since microgroove players became available, there has been a steady flow of letters from harassed fathers, who were left with a single-speed player on their hands "Are they good for anything?"—they wanted to know.

USING OLD UNITS

And, of course, Junior wanted to know if he could have the old unit and "try to make it work again".

Well, most of these units should be in reasonable order and, in all probability, would have carried out their job for years to come had not the fast development of "something new" put a premature end to their career. The same applies to a stack of old records, which would sound scratchy with any of the new pickups and cannot be used any more.

As a matter of fact, the writer himself faced a somewhat similar situation some time ago, although he is not as yet a family man.

One of our recent correspondents, however, went a good deal further. He wanted a circuit for a small, inexpensive radio set or amplifier, which could be used in conjunction with such an old record player unit, to provide Junior with a program selection of his own.

The idea seemed so good, that we promised the gentleman in question that we would publish such a circuit very shortly.

Well, here it is: The "1955 BABYGRAM".

Requirements for a set of this nature are few and simple. It should have reasonable gain and selectivity to allow good reception of the local stations and an output stage capable of giving adequate (but not excessive) volume from records.

Circuit and layout should be simple and straightforward, using a minimum number of parts to keep the cost down to a reasonable figure.

As we inferred earlier, it's not the kind of set we would recommend for the country listener, or for anyone who lives right in the shock area of one particular station.

But it can be recommended to any of the countless listeners who live in ordinary houses in ordinary urban areas.

The 1955 Babygram fulfils all these conditions and yet gives a surprisingly good account of itself.

Here are the details of the circuit:

A tuned RF stage with diode detection, utilising a 6N8 valve, was used in preference to the time-honored leaky-grid detector, because it uses two tuned circuits, thus improving the selectivity. A second diode in the valve was used to obtain AVC voltage.

Fixed reaction to the aerial coil usefully increased both the selectivity and the sensitivity. At the same time, the reaction control has been eliminated as an extra knob.

Originally intended for use in television receivers, the second valve—the 6AB8—gives quite acceptable results as a combined audio amplifier and power output valve. It is used for this purpose in the present set.

The output voltage from the diode, or alternatively from the pickup, is fed to the grid of the 6AB8 triode through a .5 meg volume control. This section uses a conventional R/C circuit.

Amplified signals from the triode drive the pentode section of the valve. A tone control operates as usual in the plate circuit of this pentode section.

Back-bias had to be used for the 6AB8, as the two sections of the valve have a common cathode but require different values of bias.

A high tension supply of 200 odd volts is supplied by a 6X4 rectifier and a simple resistance-capacitance filter.

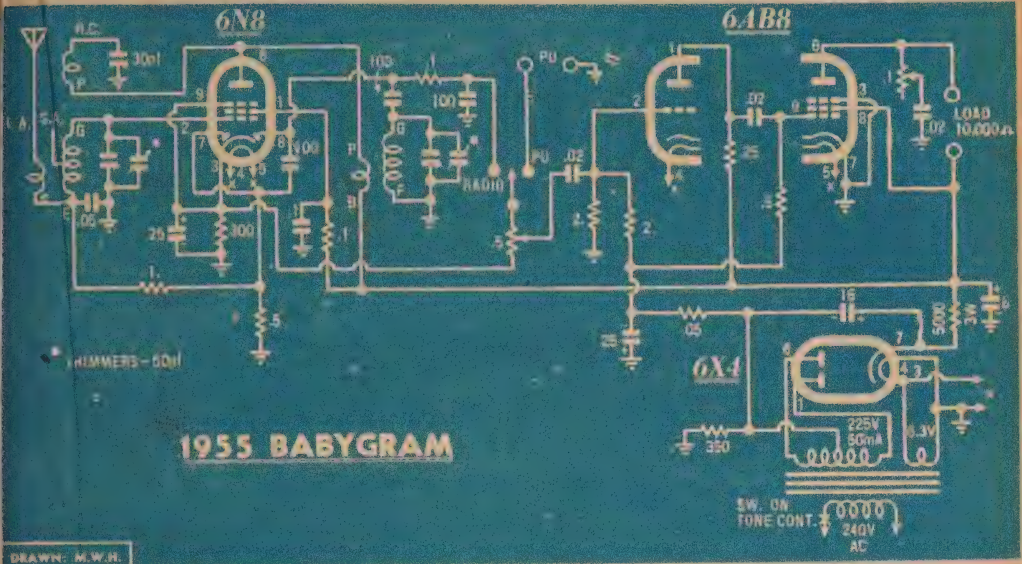
DETAILED DESCRIPTION

So much for the circuit.

We propose to describe the actual construction in detail. This description, together with the wiring diagram elsewhere in this article, should enable anybody capable of handling a soldering iron to put the set together.

The set is built on a chassis measuring 8½ x 5 x 2½ inches. Actually

CIRCUIT DIAGRAM OF THE NEW 1955 BABYGRAM



The circuit is simple and straightforward with no catches or tricky adjustments. It uses the latest miniature valves for improved performance.

it is identical to the chassis used in an earlier version of the "Babygram" and should be available through the normal channels. No great difficulty should be experienced, however, in bending it up from a sheet of 18 gauge aluminium, if you are disposed to do so.

Altogether five major holes and a cutout are required on the chassis. Of these two ¾in and two 1 1-8 diameter are situated on the left-hand side of the chassis to accommodate valves and coils. Their exact position can be seen from the diagram.

To allow the dial mechanism to be placed into position without the need for dismantling, the front edge of the chassis is cut away. This leaves a hole 3in wide, extending ½in into the top and 1¾in down the front of the chassis.

Just 3½in from the right-hand side, along the rear edge, another hole, 5-8in dia. is made to accommodate the rectifier socket.

Several smaller holes are required for mounting the different components. Their position will largely depend on the size of components used.

COAT OF PAINT

Place these items on the chassis and mark the mounting hole positions. They are best removed from the chassis for drilling, because a slipping drill may easily damage them.

To make the finished chassis look neat and clean, it could be rubbed down with fine emery paper and perhaps given a coat or two of quick-drying enamel.

Paint is not a good electrical conductor. To ensure good earth connections to the chassis, the paint should be scraped away under the mounting screws on the underside of the chassis.

As a further precaution soldering lugs should be clamped in the following positions:

Front mounting screws of power transformer, gang mounting screws, and the inside screw of the RF coil.

Further solder lugs are placed under one of the pickup terminals and the earth terminal. They are not insulated from the chassis.

These lugs can be mounted in much the same way as washers, when screwing on different parts. Tagstrips can be fixed in the same way.

These tagstrips serve to hold the junction of various circuit components in place, when they cannot be soldered directly to terminals. They make for firmer wiring and a neater appearance.

Two tagstrips are required to keep the filter capacitors and the back-bias components in place. The most convenient position for them is under the two rear screws of the transformer.

In addition there is one four-lug strip for the 6N8 and one for the 6AB8. The first is placed about half way between these two sockets, the second fixed under the rear mounting screw of the RF coil. The lug protruding over the coil base is not required and can be cut off.

All the soldering lugs, as well as the earthed lugs of the tagstrips can then be interconnected with tinned copper wire. Two advantages are gained by this: An unreliable earth contact will not upset the performance, and convenient earthing

PARTS LIST

Chassis 8½ x 5 x 2½in. (New Babygram).
Power Transformer, 225/225V, 50 mA, 6.3V 2A.
Two gang tuning capacitor (AWA min. or similar).
1 Standard RF coil (Iron cored).
1 Standard Reinartz coil. (Iron cored).
1 Dial USL 44, with glass to suit gang.
1 6X4, 1 6N8, 1 6AB8 valves.
1 Permag. Speaker with transformer to suit. (Preferably 10,000 ohm).

CAPACITORS:

1 16 mfd 525V electro. 1 8 mfd 350V electro. 2 25 mfd 40V electro
1 .1 mfd 400V. 1 .05 mfd 200V. 3 .02 mfd 400V, 100pf mica, 3 50pf trimmers.

RESISTORS

2 2 meg. 1 1 meg. 2 .5 meg. 1 .25 meg. 2 .1 meg. 1 .05 meg. 1 300 ohm. all ½ watt. 1 350 ohm 1 watt, 1 5000 ohm 3 watt.
1 .5 meg. pot, 1 .1 meg switch pot. 1 single-pole 2-pos switch. Oak type.
2 9-pin valve sockets min. 1 7-pin valve socket, min. 2ft shielded hookup wire.
2 red and 2 black spring terminals. 1 4-pin min. speaker socket and plug. 3 4-terminal strips, 1 2-terminal strip, power flex and plug.

SUNDRIES

Nuts and bolts, hookup wire, tinned copper wire, spaghetti, solder, solder lugs, knobs, dial lamps 6.3V (if required.).

Ideal for outside soldering

No doubt amateurs and hobbyists have experienced the difficulty of trying to make soldered joints in locations where there is high wind and have found it virtually impossible with ordinary type irons.

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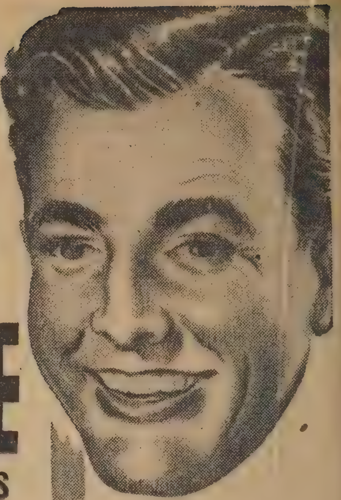

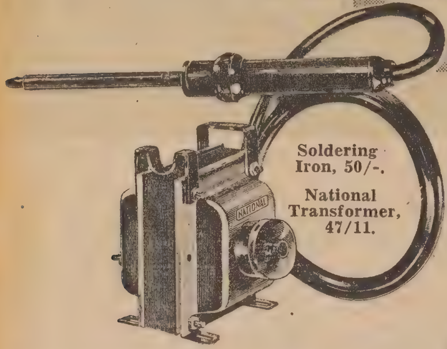

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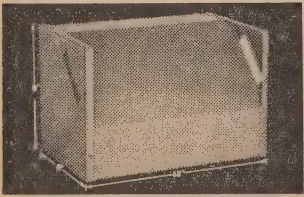

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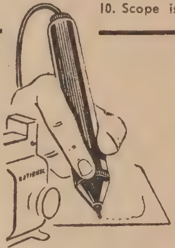

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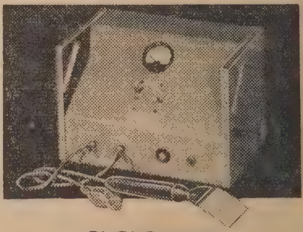

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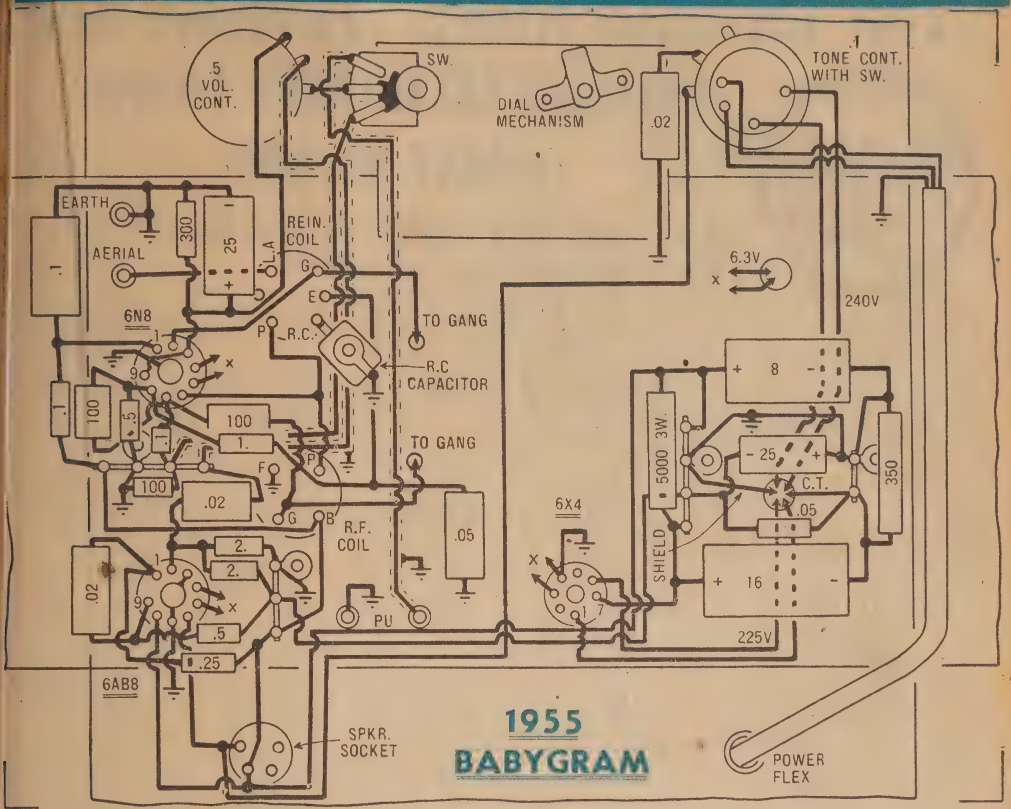


This wiring diagram will help the not-so-experienced constructor over the difficulties of radio construction. Note that the coil connections are marked for one particular brand of coil only. Other brands may have different connections.

points are provided right through the chassis.

Wiring is made much easier and instability is less likely to occur, if the position of the socket pins allows short connections to various parts of the circuit.

This is best achieved in the present set by pointing the gap between pins 1 and 9 on the 9-pin sockets toward the side of the chassis. The position of the rectifier socket is not critical, although a neat layout was obtained by pointing the gap between pins 1 and 7 toward the rear.

DIAL GLASS

To complete the mechanical construction the gang, the dial and the controls can be fixed to the chassis. The dial glass is best removed, until the wiring is completed. Dial glasses are very easily broken in the course of construction.

It may be awkward to connect wires to the gang after it has been screwed into place. If the wires are soldered to the stator terminals before mounting, this difficulty will be avoided.

This much done, we can now turn our attention to the wiring.

The leads from the power transformer are best disposed of first. According to the manufacturer's code, select the leads to the primary and connect them to the switch on the tone control.

There are a number of makes of switch—potentiometers on the market. They may or may not have the same connections as the one shown in the wiring diagram, which, incidentally was made by IRC. As this switch is connected straight to the mains, utmost care should be exercised to make sure the leads are connected to it in the right sequence.

The centre tap of the high-tension winding should next be taken to the insulated lug on the small terminal strip on the right, while the two outer ends connect straight to pins 1 and 6 of the rectifier socket.

The ends of the 6.3 V winding are taken straight to pins 3 and 4 of the rectifier socket, then taken from there to the filament pins of the other two sockets (4 and 5).

BACK BIAS

Owing to the biasing arrangement, a little care is necessary, when wiring the HT filter. The negative side of the first filter capacitor is not earthed, but connected to the centre tap of the HT winding on an insulated lug. The back bias resistor, 350 ohms, is connected between this lug and earth.

The second filter capacitor is earthed in the normal manner. Parallel to the tag strip we have the HT dropping resistor (5000 ohms, 5W), suspended between the two end lugs of the tagstrip.

The bias decoupling capacitor and resistor occupy the remaining insulated lug on this strip.

All the leads from this section are neatly tucked away into the corner of the chassis. One of the speaker socket terminals is used as a distribution point for the HT.

SMALL COMPONENTS

To avoid congestion in the wiring, miniature resistors and capacitors have been used. They are generally available now, and no difficulty should be experienced in obtaining them. Miniature components being what they are, a pair of tweezers is a very handy tool to have in hand.

Tweezers also provide a certain amount of heat shunting, thus preventing heat damage to resistors.

When wiring the 6N8 and 6AB8 sockets, it is important to earth the centre spigot on the socket. This provides a shield between opposite

"The GRAMOPHONE" reviews the

VARIABLE-RELUCTANCE Turnover PICKUP No. 500

Goldring

Read what P. WILSON, M.A. reports about this outstanding production.

● *Mr. Wilson's technical reports in the English magazine "The Gramophone" are world-famous for their thoroughness and objectivity. In the January 1955 issue he reviews the Goldring "500" Pickup. An abbreviation of his article is reprinted, with full acknowledgment, below.*

"This latest Goldring Cartridge. No 500, has an exceptionally long frequency range, and I have not been able to detect any non-linear distortion even on records of large amplitude. Its design, indeed, seems to have solved all the problems which some of us encountered when we made our moving-iron pickups in prewar days.

Here are the details as given in the makers' list:

Specification:

Type: Magnetic Reluctance Turnover Cartridge.
Styli: (1) 0.0025 in. rad. sapphire or diamond for 78's.
(2) 0.001 in. rad. sapphire or diamond for LP's.
Normal tracking pressure: 7 grams.
Lateral Compliance: Better than 3 x 10-6 cm/dyne.
Effective mass at stylus tip: 3.5 milligrams.
Output (average): 3.2 mV per cm/sec. (on loud record) 35 mV.
D.C. Resistance: 1500 ohms.
Impedance at 1000 c/s: 3800 ohms.
Recommended load resistance 50,000 ohms.
Frequency response: Substantially linear from 20 to 16 kc/s (and to over 20 kc/s on shellac discs).

The cartridge encloses a permanent magnet with two sets of pole pieces embraced by a common twin-coil system. Two poles are on one face and operate with an "armature" of cantilever type to produce tiny electric signals from 78 r.p.m. records. Two other pole pieces are on the opposite face and are used in conjunction with a separate cantilever armature and a stylus for LP records. There are no moving parts common to the two uses and therefore there is no unnecessary mass. So the H.F. resonance of each system can be kept high. This is a tremendous boon, and means that with this design all the convenience and cheapness of a turnover cartridge can be secured without any disadvantage whatsoever.

The freedom from non-linear distortion has been secured by having an exceptionally large gap between the pole pieces and by having no unbalanced damping on the armature. For this advantage, of course, a price has to be paid in the way of sensitivity. Still, an output of 3.2 millivolts per cm/sec. is sufficient to load an amplifier plus pre-amplifier system, such as the Pye, or Pamphonic or Quad II or Leak without the use of a transformer. Notwithstanding the low output voltage and comparatively high working impedance load, the hum voltage is remarkably low, owing to the balanced (push-pull) coil system. This way of avoiding hum from stray magnetic fields is a valuable feature of the design. Electro-static hum is comparatively easily avoided by the use of careful screening; but electro-magnetic hum can be the very devil.

The cantilever armatures carrying the styli on each side of the cartridge are quite tiny affairs. They are not mechanically damped in any way and so the freedom of motion is exceptionally high. On the other hand, this also means that the high-note resonance is undamped. There is thus a small peak (it really is very small) in the region of 13-14 kc/s for LP records and 20 kc/s for shellac discs. This peak is barely detectable in actual playing conditions even with the most difficult records; and I have found that it is possible to remove it almost completely by painting the cantilever very lightly with a solution of soft p.v.c. (or viscaloid) in chloroform.

I apologise to the more unversed amongst my readers for being so technical and formal. My excuse is that it is quite an occasion to have a pickup of so interesting and successful design to analyse. It is not very long ago that I should have been very sceptical about the possibility of making an electro-magnetic pickup of such a calibre, and particularly one embodying the cantilever principle with all the advantages of high vertical as well as lateral compliance. Well, here it is and at a remarkably cheap price; and, I should think, with this particular style of design carried about as far as it could very well go.

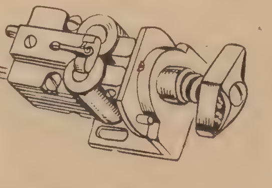
The cartridge can easily be mounted in one of the pickup heads that are usually used in this country for turnover pickups.

1. The output of the 500 is comparable to that of the moving-coil type, but its impedance is higher. It is therefore rather more senstiive to electrostatic hum; I have, however, found no difficulty in obtaining adequate screening. On the other hand, it is much less sensitive to electro-magnetic hum.

   Its price is, of course, much lower than that of any good moving-coil pickup.
2. The stylus compliance is greater than that of even the best crystal pickup, though its output is much less. Its price is about the same.

   Its performance is hardly affected by temperature changes as is Rochelle Salt. It is therefore particularly suitable for tropical countries, whereas Rochelle Salt loses its properties at about 50 deg. C. (120 deg. F.). No Ceramic pickup I know of as yet can equal it in performance, except as regards output.
3. It is less susceptible to non-linear distortion (and electro-magnetic hum) than other designs of moving-iron pickups at present available, and its useful frequency range is longer. Its lateral compliance is greater and its vertical compliance much greater. It will therefore track comfortably at smaller stylus pressure. Most other types I know of have not the advantages of cantilever mounting or of innocuous turnover facilities.
4. It is not dependent for its good performance on the quality of the pivoting of the moving parts or damping arrangements. Apart from accidents, therefore, its performance is likely to stay put.

Since I wrote the foregoing I have received a copy of letterpress and curves which are being printed in the new Goldring "Service Notes" for operating the 500 pickup. I warmly commend them. I know of no other pickup for which such full technical and practical details are given."



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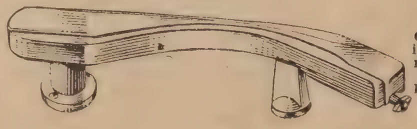

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ins and minimises the risk of feed-ack and instability.

For interconnecting leads, tinned opper wire with spaghetti sleeving, ather than plastic hookup wire can ell be used. The reason for this is at, in small sets like the present ne, the plastic insulation can very asily be damaged by the hot soldering iron.

All components around the 6AB8 ocket are suspended between the ppropriate pins and lugs on the erminal strip. The only exception the .02 coupling capacitor between he triode and pentode sections of his valve. This is suspended directly etween pins 1 and 9 of this socket.

ARGE COILS

Using standard size coils in a re-eiver built of otherwise miniature omponents may seem somewhat in-ongruous. The point is, however, hat we are not trying to make the et specially small and there is a ood chance that the larger coils vill be more efficient than their niniature equivalents.

Iron-cored coils should be used, so that the stations can be brought into line with the dial markings. This is quite an important point.

We may mention here that the coil onnections on the wiring diagram re drawn for RCS coils, which have een used in the prototype. Other nakes of coils will work just as vell but they may have different onnections. Check this point, before roceeding with the wiring.

The wiring of the 6N8 socket re-uires some care. Before mounting ny of the components, pins 3 and will have to be bridged with a iece of insulated wire. Then the hielded leads to and from the volume control are put into place, con-ecting to two lugs on the terminal trip. This procedure is necessary, ecause other components are nounted over them. The same pplies for the .0001 mica capacitor etween the two diodes.

The remaining components can then be put into place. Neatly tucked away in the corner are the screen bypass, and the cathode resistor and capacitor.

The shielded lead from the pickup erminals is connected to the change-over switch.

With all leads in position the reaction capacitor and the AVC decoupling capacitor are connected between the respective coil terminals and earth.

POWER FLEX

All that remains now is to connect the power flex to the switch on the potentiometer. Note that the green lead connects to the chassis and make sure that it is connected to the pin marked Earth in the plug.

If you haven't made any mistakes in the wiring, the set could now be put into operation. But take our advice and try the filament pins with a 6.3V lamp first. For this test the set should be connected to the mains without the valves in their sockets. Valves are expensive these days!

If everything is OK the loudspeaker and the valves can be plugged in and the set switched on again.

There should be some kind of sound emanating from the speaker, if an aerial is connected, but it may not be pleasant. It will take a certain amount of juggling with the trimmers, coil cores and reaction capacitor to get the best results.

The alignment is very simple and no signal generator is required. Begin with both gang trimmers about half in and the reaction trimmer fully open.

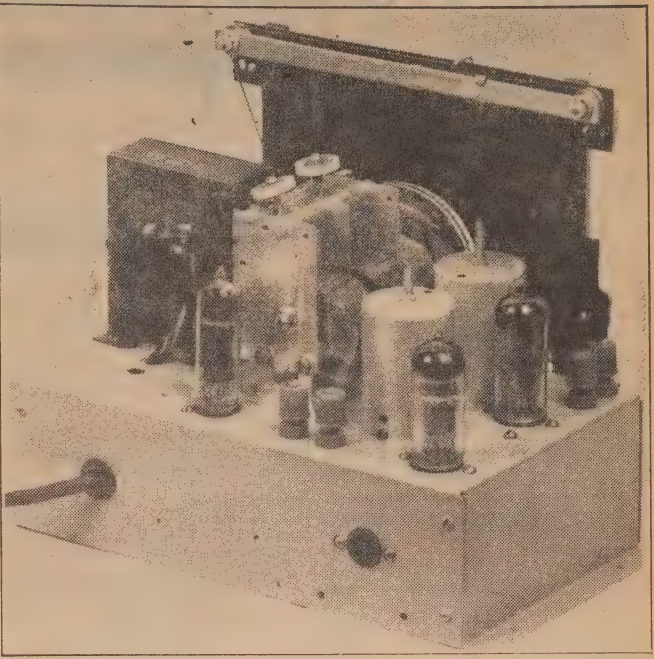
Adjust the pointer for equal overlap with the tuning gang both open and fully closed. Tighten the dial drive drum on the shaft.

With small sets of this type the length of aerial used will affect both the tuning and the volume. It would therefore be useful to connect the aerial which is to be used to the set for alignment. Ten to 15 feet of insulated wire will most likely be plenty in most areas.

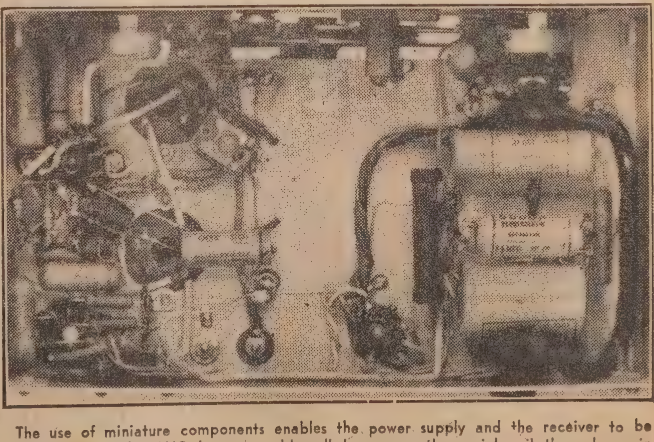
This much done, the alignment proper can be proceeded with.

With the pointer just beyond 2SM, near the high frequency end of the dial, the reaction trimmer under the chassis is screwed in just to th threshold of oscillation. This should provide sufficient reaction right

BABYGRAM CHASSIS—REAR VIEW

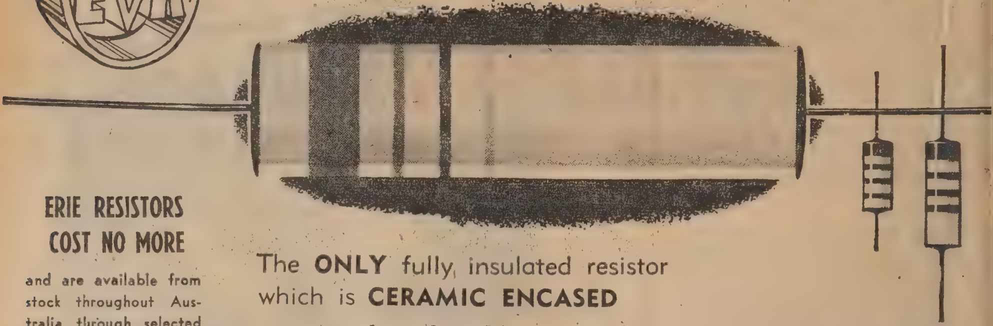


The rear view shows the layout of parts on top of the chassis. The trimmers are soldered directly to the gang connections.



The use of miniature components enables the power supply and the receiver to be kept apart. The AVC bypass could well be nearer the aerial coil than shown in this picture.

ERIE RESISTORS..



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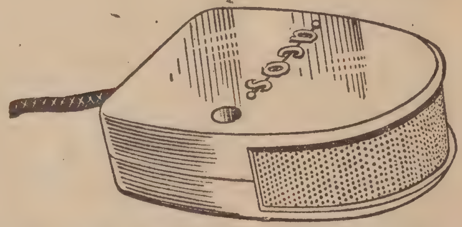

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Approximate capacitance of the microphone is 750pF and cable capacitance will reduce output proportionately.

Frequency response	Substantially flat from 50/5,000 cps.
Output level	≃ 55 db ref. 1 volt/dyne/cm2.
Load resistance	2 megohms included.
Cable	This microphone is supplied with approximately 4ft. 1.2 metres of co-axial cable (type Unirad 32).
Weight	Microphone only — 6oz. (approx. 170 grammes) complete with packing 7oz. (approx. 198 grammes).
Dimensions	Microphone only 2 7/8in x 2 1/8in x 7/8in plus cable. Complete with packing 3 3/8in x 2¼in x 2¼in.

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hrough the band, without the set ursting into oscillation.

Then, with the pointer set to 2FC, oth coil cores are adjusted, until his station is heard at maximum olume.

Tuning back to 2SM, the same rocedure is repeated with the trimners. As this may have caused scillation, it would be best to check he reaction capacitor again, always eeping it set to just below the point f oscillation at the high frequency nd of the band.

With the pickup connected to the erminals the set is ready to be placed nto whatever cabinet you have hosen for it. Note that some older ype magnetic pickups require a .05 neg. resistor across the terminals for est results.

A good scheme would be to mount he turntable, radio and loudspeaker nto a small bedside cabinet.

We have mentioned at the beginning of this article that this set is ot a toy. Therefore make sure hat there is no chance of anybody getting their hands into the set, particularly if it is to be used mainly y children.

BOOK REVIEW

TELEVISION RECEIVER SERVICING (Vol. 1) By E. A. W. Spreadbury. Stiff covers, 310 pages, 34/9 Aust. (approx.). Our copy from the publishers.

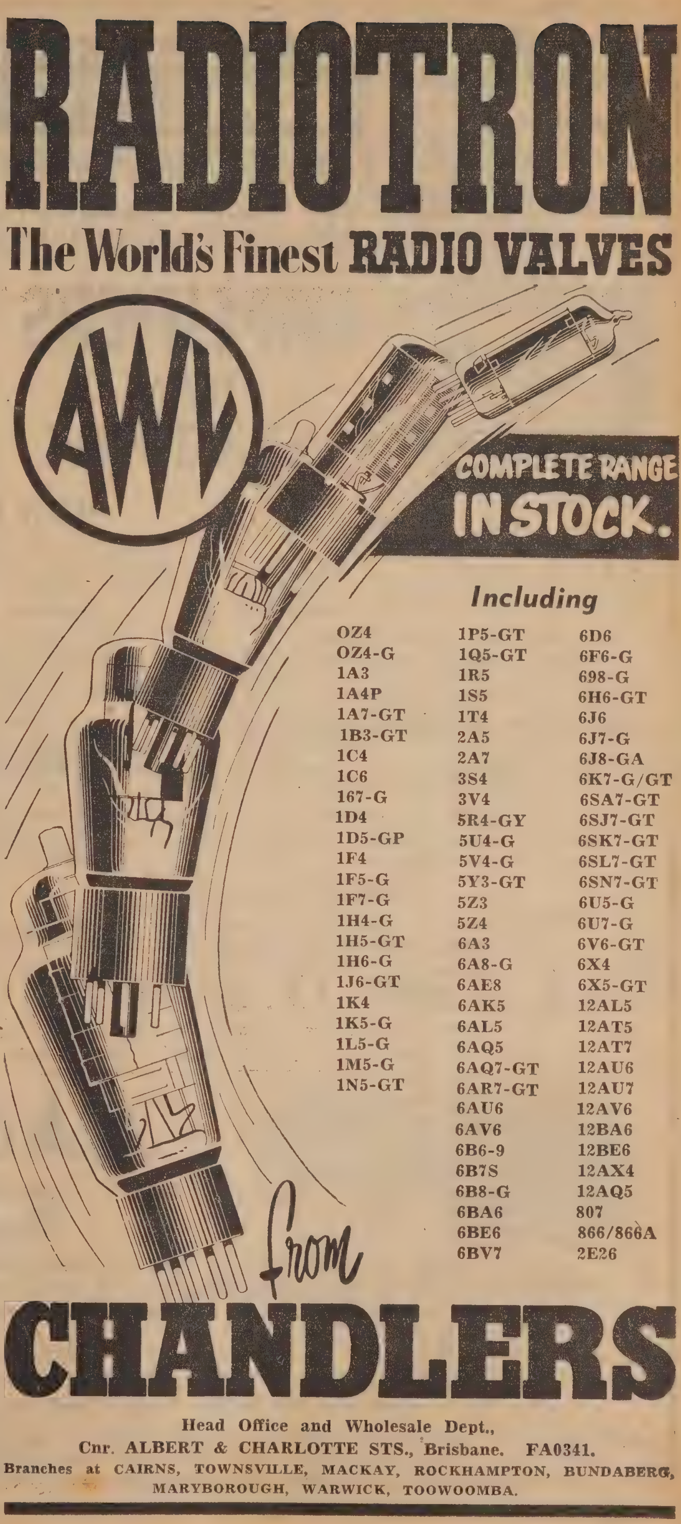
This book is one of two volumes intended to assist radio servicemen in their conversion to servicing television receivers. It deals mainly with the time base circuits, wherein, according to the author, at least half of the troubles in television receivers occur. The second volume, to appear shortly, will cover the remainder of the receiver.

It does not attempt to teach the principles of radio servicing. Instead it assumes that the reader is already familiar with this subject but wishes to extend his knowledge to cover the more complex circuits and techniques of television.

The author describes, in a practical and straightforward manner, each section of the receiver, and shows the reader how to check that the waveform is correct at the input and output of each section.

The book is profusely illustrated and there are many practical circuits given and which are discussed in detail in the text. Synchronisation, interlace, EHT circuits, salvaging picture tubes, flywheel circuits, and typical test instruments are some of the subjects covered.

Altogether, this book, and its companion, would appear to be the answer to the local radio serviceman who may be viewing with apprehension the advent of television on the Australian horizon. Allowing that the English system is different from that visualised in this country, it should still prove extremely valuable to the Australian reader and should serve to prevent a feeling of being "completely lost" when first confronted by a television receiver.



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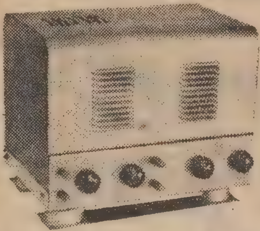

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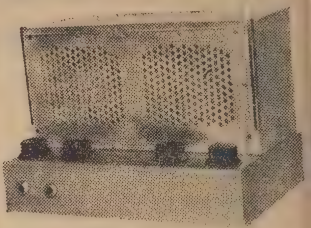

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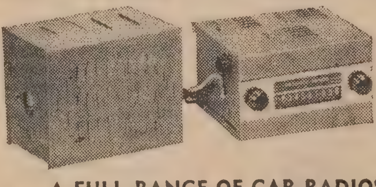

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A BOOK ON ELECTRONIC MUSIC

THE ELECTRONIC MUSICAL INSTRUMENT MANUAL by Alan Douglas. Hard cover, 221 pages. Published by Sir Isaac Pitman & Sons, London.

Readers who have an urge to build an electronic organ or some such device, will find plenty to interest them in this book by Alan Douglas. First published in 1949, the book has been revivsed and enlarged to constitute a second edition (1954).

The first three chapters deal in a concise but informative way with the physics of Sound, Music, Noise and conventional musical instruments.

With this as background material, the writer then goes on to a lengthy discussion of the means by which equivalent signals are generated electrically. He discusses fundamental and harmonic tones, tone structure, angular waves, formants and so on.

Numerous circuits are given for valve oscillators and frequency multipliers, followed by a discussion of tone production by electro-mechanical means. This discussion covers most, if not all, the circuits and tone generating systems used to date in commercial electronic instruments. It is quite full in its treatment.

Chapter 5, logically enough, is a treatise on amplifiers, tone controls and loudspeaker equipment, of the type most likely to interest "domestic" music enthusiasts.

How all these ideas are applied in practice is the subject of Chapter 6. This explains the operation of many commercial electronic instruments, even to circuit diagrams in some cases. Of special interest is the circuit of the now popular "Clavioline".

The final section describes a few odd gadgets and experiments which the author anticipates will be of interest to home constructors. Among these is a simple one-finger oscillator, on which simple melodies can be played.

All in all, it is a book which should provide absorbing reading and a great deal of information for anyone keen on experimenting with electronic music.

Local price is approximately £2/5/-. (Our copy from the Electronic Organ Co. (Aust.), 9-11 Cadow St., Pymble, NSW.)

TV SERVICING

TV Repair Techniques, by selected authors. Gernsback Library No. 50, published by the Gernsback Publications, Inc., New York.

The book sets out to present a practical help for the servicing of TV receivers. Problems are approached from the practical rather than the theoretical angle, considering the actual fault symptoms and prescribing a remedy for them.

The large number of typical circuit diagrams and photos of fault conditions on TV screens make the book very interesting and easy to understand.

Each chapter is by a different author, each treating a separate aspect of TV servicing.

The chapters originally appeared as independent articles in the American magazine Radio Electronics.

Some of the chapter headings may give a rough idea of the contents: Unusual TV Troubles; TV Signal Tracing; High Voltage and Boost Voltage Headaches; Correction of Picture Distortion; and the ever present subject of Television Interference.

Although dealing with typical American circuits, the book is likely to give many useful hints and general understanding of TV faults to local servicemen when television ultimately is introduced here.

RADIO CONTROL

RADIO CONTROL HANDBOOK by Howard G. McEntee. Soft cover, 192 pages. Published by Gernback Publications Inc. Our copy from the publishers.

This appears to be a very comprehensive book on the always popular subject of radio control for models. The approach is an entirely practical one, the author assuming that the reader already possesses a fair knowledge of electronic theory but needs some guidance in putting this knowledge into practice in this particular sphere.

This is revealed immediately one opens the book. In place of the usual introductory chapters on elementary radio theory the first chapter is devoted to the practical design of simple control systems, the radio link being temporarily forgotten.

The second chapter is devoted to more complex control systems, detailed constructional data being given for various actuator devices. Chapter three covers the problems of speed control for motors, particularly the miniature internal combustion engines used for model aircraft. Other control devices are also included in this section.

Following this is a chapter devoted to single-valve receivers which, after a very brief introduction goes straight into the design of a practical single-valve receiver. Next come multi-valve receivers and then transmitters with details on the construction of a crystal-controlled transmitter.

This is followed by a section devoted to test equipment and, finally, there are descriptions of equipment for a model boat, a model car, and a model tractor.

For anyone who has studied previous publications on this subject but who still feels a little diffident about tackling the actual construction, this book should be the answer.

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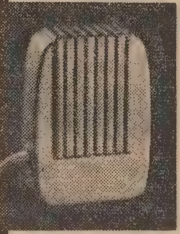

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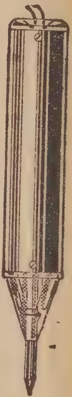

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RESISTANCE VALUES — Carbon Types: 500 to 10.0 Meg.; Wire-Wound Types: 5 to 10,000.
TAPERS—Carbon Types: Linear A or log. C. Wire Wound: Curve A (linear).
TOLERANCES—Carbon Types: ±20%; Wire Wound: ±10% Special tolerances available at extra cost.
SHAFT DETAILS — Inner Spindle, length 1⅞ins. (controls rear unit), .187in. diameter. Outer Spindle, length 1⅜ins. (controls front unit), .265in. diameter. Flats or screwdriver slots available for quantity orders.

4 Type CS Metallised Controls

RESISTANCE VALUES—500 ohms to 10 megohms in log. or linear taper.
TOLERANCES — Standard ±20%; ±10% available at extra cost.
POWER DISSIPATION—½ watt over entire element for linear taper with power dissipation proportionate to rotation.
ROTATION—280° standard.
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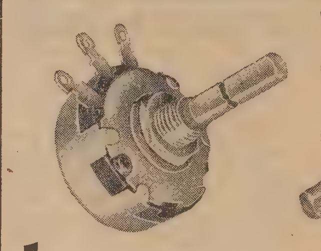
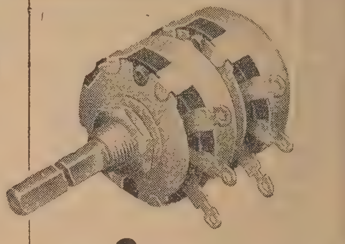
TAPS—One standard, also centre tap controls available in linear taper in 500,000 and 1 megohm.
TAPERS—Logarithmic and linear standard.



1 Type W Wire-Wound Control



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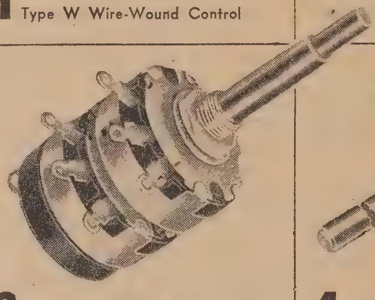
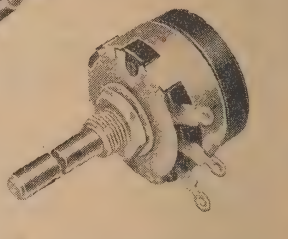


3 Concentric Dual Control



4 Type CS Metallised Control

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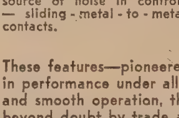

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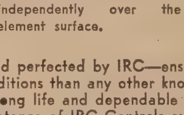
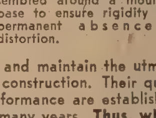


The famous IRC multiple fingered knee action contacts are silver-plated, and each is free to glide freely and independently over the element surface.



The durable metallised type resistance element has a glass-like surface which is baked on to a moisture-proof base. The control is assembled around a moulded base to ensure rigidity and permanent absence of distortion.

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THE KIPP OR ELECTRONIC RELAY

In the February issue, we featured an article on the "Flip-Flop" circuit and, in particular, the multivibrator or relaxation oscillator. Here is another variant of the same basic circuit, the Kipp Relay, which is finding increasing application in modern electronics.

THE multivibrator or relaxation oscillator is characterised by having two unstable states, due to capacitive coupling between each anode and the opposite grid. The output from either anode is a continuous series of rectangular waves indicating the extreme change in voltage of the anode when the circuit changes from one state to the other.

The circuit will now be considered when the coupling components are resistors as is shown in figure 1.

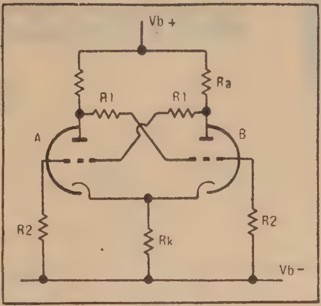


Fig. 1 — Kipp Relay circuit.

It will be seen that each grid is connected to the junction of two resistors which form a potential divider, the upper end being connected to the opposite anode and the lower to the negative side of the supply (- Vb).

GRID POTENTIAL

The potential of the grid will, therefore, be determined by (a) the potential (Va) of the anode and (b) the ratio of the values of the two resistors.

In this circuit the cathode resistor comes into the picture by keeping the potential of the cathodes at an equal and positive value. If, as is usual, both triodes are operating under identical conditions, then the cathodes will be held at the same potential irrespective of which triode is conducting.

For certain applications, such as when the two valves are not similar, an alternative method is used, whereby the cathodes are connected directly to earth and the high tension return is held considerably negative to earth. This is shown in figure (2).

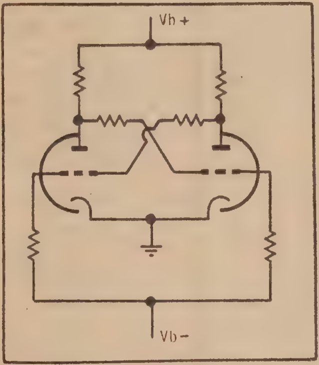


Fig. 2 — Alternative arrangement of circuit.

The operation of the Kipp Relay is easily understood if the method of design of such a circuit is studied and the general form is given below.

For the purpose of demonstration a pair of identical triodes having Ia-Vg characteristics as shown in figure (3) are taken.

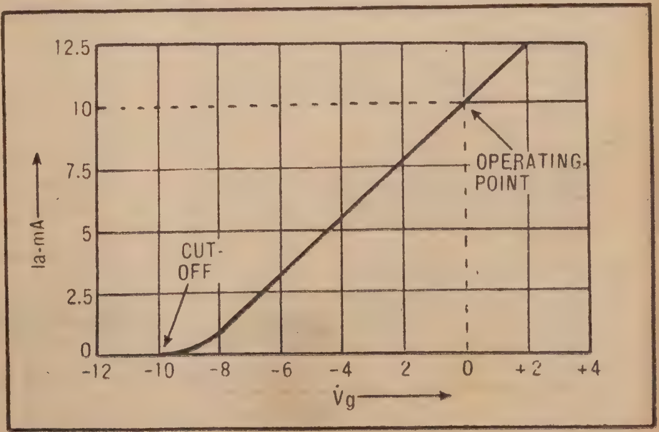


Fig. 3 — Ia Vg characteristics of triode valve

TRIODE EXAMPLE

The characteristics are similar to those of the 6J6 valve which is widely used for these types of circuit, being a common cathode double triode valve.

A suitable anode current is 10 mA which reference to the curve of Ia-Vg shows to be passed when the anode-cathode voltage is 200 volts and Vg = 0 (from cathode). Further reference to the curve shows that Ia=0 when Vg= −10, the point of cessation of anode current being called the cut-off point.

In order to satisfy the general conditions of a Flip Flop circuit whereby one triode is conducting and the other completely cut off, the following conditions must apply:—

(a) The grid of one triode to be at a potential of 0 volts with respect to the cathode

(b) The grid of the other triode to be at a potential of less than −10 volts with respect to the cathode.

The condition (a) means therefore that the triode concerned is passing a current of 10 mA and its anode potential will be Vb — 0.010 x Ra, where Ra is the anode resistor. A suitable voltage drop across Ra would be 100 volts so making the potential of the anode (Va) 150 volts with respect to Vb negative.

The condition (b) means that the anode potential of its valve will equal Vb as there is assumed to be no voltage drop across Ra when no anode current is passing.

A convenient figure for the potential of the cathode (Vk) is 50 volts and, like all the other values, is used only for convenience in demonstrating the method.

OPERATING LIMIT

In practice other conditions often place a severe limit on the operating conditions and, like all other designs, a compromise between conflicting factors must be made.

The individual resistor valves are now calculated as follows:—

(i) $Ra = \frac{Vb - Va}{Ia} = \frac{250 - 150}{0.010}$

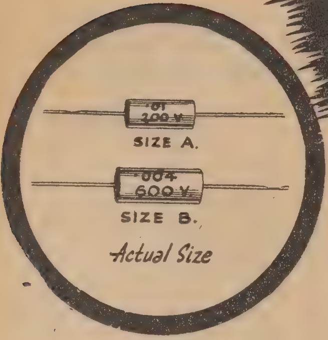
$= 10{,}000$ ohms.

(ii) $RK = \frac{Vk}{Ia} = \frac{50}{0.010}$

$= 5{,}000$ ohms.

(iii) To satisfy condition (a) the potential of the grid will be 50 volts with respect to Vb negative and the upper end of the potential divider is 250 volts from Vb positive. Therefore the ratio of voltage, and hence the ratio of resistance of R1 to R2 will be 200 : 50.

If this ratio is considered when



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.03 "	B	300 "	A
.04 "	B	500 "	A
400 Volts D.C. Wkg.		.001 uF	A
.001 uF	A	.002 "	B
.002 "	A	.003 "	B
.003 "	A	.004 "	B
.005 "	B		
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INSULATION RESISTANCE:

Not less than 20,000 megohms for all values at working voltage at 20°C.

POWER FACTOR:

Better than 1% at 1000 c/s at 20°C.

SELF INDUCTANCE:

That of a solid piece of metal of the same dimensions as the capacitor unit, less moulding, and the selected length of lead out wire.

TEMPERATURE RANGE:

− 40 to + 71°C
(− 40 to 160°F).

SELF-HEALING:

This very valuable feature enables the capacitor to sustain accidental over-voltage, and provides an additional safety factor.

TEST VOLTAGE:

150% of the working voltage for a period not exceeding 30 seconds at 15 — 20°C. Because of the self-healing feature a higher test voltage is neither desirable nor necessary.

CAPACITANCE TOLERANCE:

Standard − or + 20%; capacitances below 5 pf, − or + 1 pf. Closer tolerances of − or + 10% or − or + 5% are available for capacitances exceeding .0005 uF at additional cost.

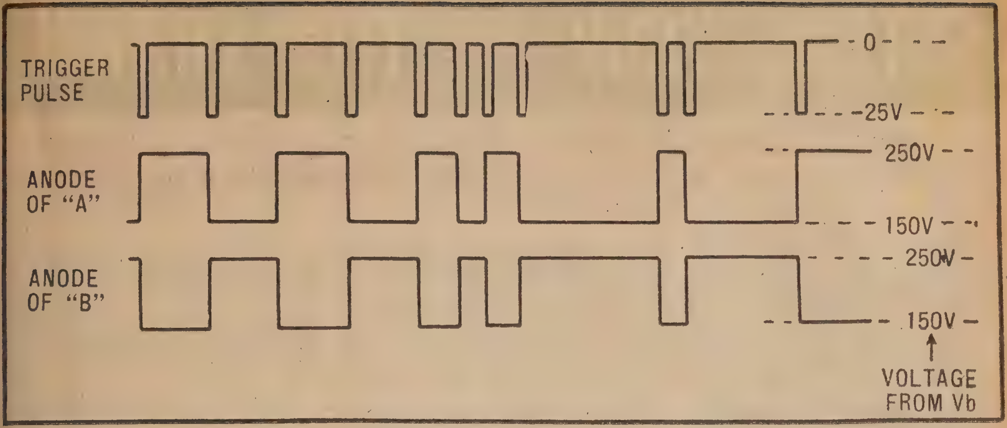


Fig. 5 — Waveforms of input and output of circuit shown by Fig. 4

Va = 150 volts then the potential of the grid would be,

$$\frac{150 \times 50}{250} = 30 \text{ volts.}$$

As this grid would therefore be 20 volts below the cathode, it adequately satisfies condition (b) with a good margin for changes to occur during the life of the valve and resistors as well as variations in supply voltages.

The actual values of R1 and R2 are decided with consideration to the lowest value and the desire to pass the minimum current through the chain. A reasonable value would be 1 megohm for R1 and .25 megohm for R2, which would only reduce the anode voltage by 2 volts in 250 so would not upset previous calculations.

It will be seen therefore that, in either state, the circuit is in an extremely stable condition requiring a voltage change of at least 10 volts, applied to one of the grids, to cause a changeover to the other state. Hence the distinguishing characteristic of the Kipp Relay is that it is "bistable".

THE CHANGEOVER

The mechanism of the change over is a simple matter if considered in slow motion, but in practice it occurs in nearly zero time, the small departure from the ideal state being mainly due to stray capacitances in the circuit.

Assume that triode "A" is conducting when a negative pulse of 20 volts amplitude is applied, via a capacitor, to its grid. Vg will therefore fall rapidly from 50 volts to 30 volts with respect to Vg negative and as it falls Ia will be reduced and Va will increase to a maximum of 250 volts. Vg of triode "B" will therefore increase from 30 volts to 50 volts and Va fall from 250 volts to 150 volts.

When therefore the pulse is terminated the circuit will remain in this condition until a similar pulse is applied to the grid of "B".

Apart from the above method the changeover may be precipitated by the injection of a suitably polarised pulse of sufficient amplitude at either anode or cathode, at any grid of a multi-grid valve used in place of a triode or as described below simultaneously at both anodes.

COMMON CIRCUIT

This commonly - used circuit is shown in figure (4) and will be seen to include three capacitors and an extra resistor.

The input pulse is required to be of at least 25 volts amplitude, and, although either polarity can be used it is more usual to use a negative one. The duration of the pulse must be small compared with the time constant of the capacitor and associated resistors in the potential dividing network. A usual value for the capacitors is 20-50 picafarads.

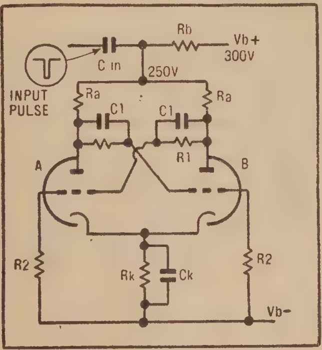


Fig. 4 — Kipp Relay arranged for Pulse Triggering.

It is again taken that "A" is conducting when the negative triggering pulse is applied via a small capacitor to the junction of the two Ra's and the resistor Rb. This latter resistor prevents the pulse from being dissipated into the low impedance supply and also further "sharpens" the pulse. Its value is conveniently 5000 ohms, and Vb is increased to 300 volts to take care of the voltage drop so introduced.

The pulse is applied to both grids simultaneously via the Ra and C, in each case so causing both grids to be driven below cut-off.

As the triode "A" was conducting, its anode will rise to 250 volts on the application of the pulse so generating a positive pulse of 100 volts amplitude This pulse is passed to the grid of "B" so driving it above cut-off.

The anode of triode "B", however, remains at 250 volts as it cannot be more "cut off" than it already was before the arrival of the triggering pulse. It is the function of the capacitors C, to hold all the potentials in this condition until the trigger pulse is terminated, after which leakage of the charges in the capacitors allows the normal state to be resumed.

From this will be seen that the capacitors "remember" which triode was conducting before the pulse arrived and ensure that the other triode is the one conducting after the pulse has passed.

Were the capacitors omitted the circuit would immediately settle down to the state where both grids were below cut-off hence, when the triggering pulse was terminated, both triodes would try to conduct and it would be left more or less to chance which one succeeded in conducting.

The capacitor in parallel with Rk is to ensure that during the short time when both triodes are non-conducting, the cathodes are maintained at the correct potential.

APPLICATIONS

In order to appreciate the importance of the correct functioning of the circuit, consider two of the most important of its applications in electronic equipment.

The first is that of a frequency divider where for every two input pulses one output pulse is generated. By using the generated pulse to trigger another Kipp Relay a further division is made, and this can be continued without limit.

One important advantage of this system is that if the original signal fails there is no self-generated output pulse of an incorrect frequency.

The circuit will readily handle pulses with a repetition frequency of 1 Mc/s if high accuracy components and a good mechanical con-

(Continued on Page 119)

GETTING YOUR AMATEUR LICENCE

In this article is discussed the general theory of radiation from a half-wave aerial, which is the fundamental element in all types of arrays, and is frequently used as a single radiator on nearly all amateur frequencies.

THE whole idea of making an antenna radiate is to transfer energy through space from one point, the transmitter, to another point, the receiver. It is important, therefore, to form some idea of what happens to the energy which is radiated, and the paths it will take in various directions from the transmitter.

It might be imagined that radiation from an aerial would take place equally in all directions, but in practice this is never the case. Such an aerial would have to be merely a point in space having no magnitude, under which circumstances it could not set up any electrical fields because no current could flow in it.

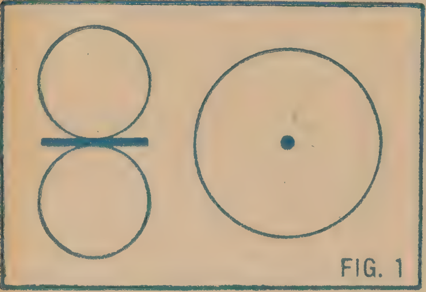
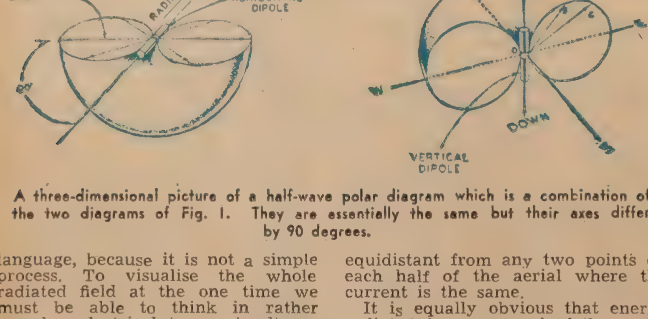


FIG. 1

At the left is the polar diagram of a free-space half-wave showing the two lobes which extend at right angles to its length. At the right is the circular pattern we see when viewing the aerial end-on.

It is essential to remember that radiation depends entirely on the building up and collapsing of such fields, and, as we have seen, the shortest length which can efficiently bring this about is a half-wavelength at the frequency being used.

It is not easy for the beginner to visualise radiated waves leaving an aerial because he must build up a picture in three dimensions. It is still harder to explain in simple language, because it is not a simple process. To visualise the whole radiated field at the one time we must be able to think in rather complex electrical terms simultaneously, and some simpler approach is indicated for use by anyone who has no immediate ambitions beyond passing his examination.



A three-dimensional picture of a half-wave polar diagram which is a combination of the two diagrams of Fig. 1. They are essentially the same but their axes differ by 90 degrees.

Let us try to analyse the process of radiation in terms of aerial current. For this purpose we will assume a half-wave aerial suspended in free space to which in some magical manner we have managed to feed RF power.

There will now be a current flow in the aerial, and as a result a magnetic field will be alternately building up and collapsing around it. We can consider the aerial as being surrounded by lines of force when the field is present in the same manner as we find lines of force around a magnet.

These lines of force will billow out from the aerial with the strongest radiation at the centre where there is the greatest flow of current.

The power radiated from the aerial in various directions will be made up of radiation from an infinite number of segments along its length. It will be greatest along a line at right angles to its centre, for points along that line will be equidistant from any two points on each half of the aerial where the current is the same.

It is equally obvious that energy radiated from one end of the aerial toward the other end will have travelled one half-wavelength by the time it reaches that end, and will therefore cancel out almost completely the energy which is being radiated there in the same direction. This cancellation will take place in part along any angle other than a right angle from the centre of the aerial, although the exact computation of the amount of cancellation becomes a fairly complicated mathematical sum.

The net result, however, is that there is virtually no radiation along the line of the aerial. If we were to move around the aerial in a quarter-circle until finally we were at right angles to it, the amount of radiation would gradually increase until it would be greatest when we were exactly broadside on.

Thus an ordinary half wave, although it radiates equally in all directions in the broadside plane, has a "null point" directly off the ends, and is therefore said to be directional at right angles to its length.

POLAR DIAGRAMS

If we were to plot the magnitude of radiation from the aerial in various directions, and mark the points at which it was equal, we could join them and draw a number of more or less circular lines which would give us the "polar diagram" of the aerial in various planes.

Fig. 1 shows two such diagrams, one drawn around the aerial broadside on and the other drawn around the aerial when viewed from one end. The first shows two circular patterns and the second a single circle surrounding the aerial. If we combine an infinite number of such diagrams so that we arrive at a solid pattern, we find its shape something like a doughnut as shown in Fig. 3.

This perfectly shaped pattern is never met with in practice, because the presence of objects such as the earth will set up reflections when the radiated energy strikes them, and will distort the pattern as a result. But it does help to fix in our minds the type of radiation initiated by the half-wave.

AERIAL HEIGHTS

It is the deliberate distortion of this elementary pattern when half-wave elements are grouped together in aerial arrays which produces the directional patterns so important in designing practical aerials.

When a half-wave aerial is used in practice, it must be suspended at a reasonable distance above ground; for we can't all have aerial masts hundreds of feet high, which would be necessary to simulate anything like free-space conditions.

As already mentioned, the energy which is radiated from the aerial down toward the ground is largely reflected from it. From immediately beneath the aerial, the reflected waves will come straight back. Those which strike the earth at an angle will be reflected also, leaving the earth's surface at the same angle at which they struck it.

Thus at any point in space the effective energy will be the result of combining two electrical fields, that provided by the aerial directly, and that provided by the energy reflected from the ground.

Obviously there will be additions and cancellations between these two fields according to whether the currents which are associated with them happen to be in phase or out of phase. If the aerial is only a quarter-wavelength above ground, the phase shift isn't very great, and the general polar diagram merely changes from a regular doughnut to that of one squashed in at the side, something like a large super-balloon tyre partly inflated and sagging under a great weight.

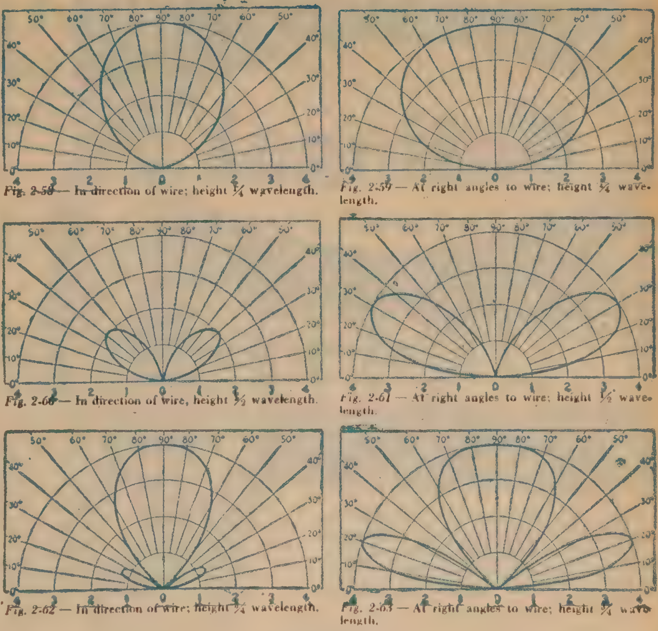


Fig. 2-58 — In direction of wire; height ¼ wavelength.

Fig. 2-59 — At right angles to wire; height ¼ wavelength.

Fig. 2-60 — In direction of wire, height ½ wavelength.

Fig. 2-61 — At right angles to wire; height ½ wavelength.

Fig. 2-62 — In direction of wire; height ¾ wavelength.

Fig. 2-63 — At right angles to wire; height ¾ wavelength.

Vertical plane radiation patterns of horizontal half-wave aerials above a perfectly conducting ground.

NUMEROUS LOBES

At heights greater than this, the combination of the two fields becomes a pretty complex affair, and the aerial polar diagram begins to break up into a number of individual lobes. The higher we go, the more there will be until, if we made the aerial high enough, the large number of individual lobes would begin to overlap and finally to merge into the solid doughnut of the ideal free-space case.

It is fascinating to examine polar diagrams for such aerials which are frequently shown in handbooks, and to trace the growth of lobes for different aerial heights. It will be seen quite clearly that if we are interested in communicating over certain distances involving reflections from the ionosphere, choice of aerial height is most important if we are to shoot a lobe at the right spot to give the desired angle of reflection down to earth.

For instance it will be noted that for quarter waves of height there is a pronounced radiation lobe directly above a horizontal aerial. There is nothing in that part of the sky but aircraft, so if we want to skip long distances, we would normally make our aerial an even number of quarter-waves in height.

SPECIAL CASE

On the other hand if we wanted to "skip" signals over short distances, we might do worse to use the odd quarter-waves of height, and take advantage of the almost vertical radiation and consequent reflection of energy.

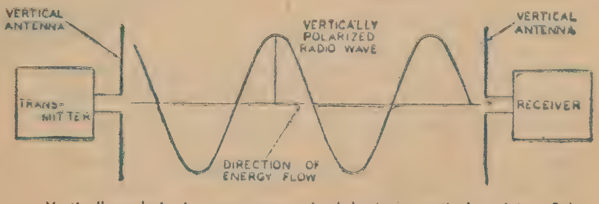
The diagram of aerial patterns illustrating the growth of these lobes was taken from the ARRL Antenna Handbook.

The patterns for vertical aerials follow the same general patterns but the development of the lobes is somewhat different because of its different initial pattern as related to the earth's surface.

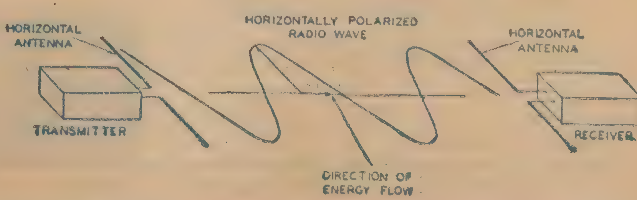
It is recommended that you study carefully the pattern diagrams referred to if you wish to get a clear idea of aerial radiatioin. It is almost impossible otherwise to appreciate the operation of aerial arrays. Equally important it is to remember that these diagrams are cross-sections of a three-dimensional radiation, but until we can get three dimensional pages in a book, they will have to do. Many schools use solid models to overcome this mental strain.

To make matters harder, few are fortunate enough to live in localities where the ground is flat for a considerable number of wavelengths in all directions around the aerial. Only if we do are all these patterns valid. If our ground is sloping, then ground reflections will tip radiation in a direction determined by the slope of the ground, and even large building structures, particularly such things as metal roofs, will do the same. All this makes it very hard to determine exactly what goes on in an aerial pattern, particularly at low angles to the ground.

It might be well to point out again that in this matter of polar diagrams and the directional effects which come from them, transmitting and receiving aerials are reciprocal in their behavior. It is convenient to consider aerials under analysis as radiating energy because



Above — Vertically polarized waves are received best on vertical aerials. Below — Horizontally polarized waves are best received on horizontal aerials.



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he mental picture is easier to achieve this way.

But the aerial pattern holds whether it is being excited by a transmitter or by enegry which has come from a transmitter. If a receiving aerial has a null point at an angle from which transmitter radiations are being received, it will receive badly from this point no matter what the characteristics of the transmitting aerial.

Obviously, the best signals will be received when both aerials have lobes lying along the angles along which the radiated energy will travel, remembering that on the bands from 3.5 to 14 Mc a great deal of it is reflected from the ionosphere, and not radiated along the ground.

IONOSPHERE CHANGES

If the height or some other conditions of the ionosphere change from hour to hour, as is normally the case, the exact point of reflection in space will usually change as well, and lobes which coincided in the first instance may no longer coincide later on when the changes have taken place.

Vertical aerials mounted close to the ground, and up to a half-wavelength long will obviously be very good if we wish to concentrate radiation close to the ground. Looking back to Fig. 3 and imagining the vertical aerial mounted on the ground, the polar diagram will be essentially that of a doughnut sliced in half, with comparatively little radiation going skywards.

This type of aerial is frequently used for broadcasting where a radio station wishes to concentrate its program coverage to a few miles in the immediate vicinity. You will undoubtedly have seen such aerials near all capital cities, and they have proved most effective.

Such aerials are not always exactly a quarter or half-wavelength long, because practical considerations, such as the attachment of feed lines, often impose limits on purely theoretical matters. Half - wave aerials in the broadcast band, too, can be collossal affairs to build.

VERTICAL AERIALS

Vertical aerials are very common in commercial VHF installations, again because of their "low angle radiation" characteristics. VHF work is almost always intended for short distances, and it is most important to avoid wasting radiation in unwanted directions. Such aerials, too, are required to radiate in many cases equally well in all directions, and the "all-round" pattern of the sliced doughnut is just the thing for them.

The ground-plane aerial so often seen with VHF gear is a vertical type with an artificial earth connected to the bottom in the form of a counterpoise.

The idea here is to preserve the low angle we get from vertical aerials mounted on the ground with the ability to raise the aerial assembly to increase the line-of-sight path. It is quite a good example of the vertical aerial technique in which use is made of its typical polar diagram.

To keep the picture of aerial fields complete, it should be mentioned that in the vicinity of the aerial itself there is a purely magnetic field which may be regarded as the primary or non-radiating field building up around the wire and collapsing back into it as the field alternates in step with the frequency concerned.

This field is equivalent to that which surrounds any magnetic device such as a power transformer.

There is a difference here, however, because at a frequency of 50 cycles, not a great deal of radiation takes place. Even so, 50 cycle aerials would be pretty vast structures.

The magnetic field of an aerial by comparison is much more extensive than that of a transformer. In the latter case we have taken care to restrict it as much as possible because we particularly wish to concentrate the lines of force, and use a closed iron core to assist us.

We can regard this field as a small store-house of energy which represents the nucleus of the electromagnetic field, and without which it could not exist.

The waves which are radiated are those which have travelled too far from the aerial with each cycle to return to it and comprise the radiated field. The "nucleus" we can term the induction field.

DETAILED TREATMENT

For those who wish to go beyond the elementary picture of radiation we have been forced to use in this article, the Admiralty Handbook of Wireless Telegraphy. Volume 2 contains a very good mathematical treatment covering several pages which will provide a much more exact explanation.

It will also demonstrate the difficulties of the simpler approach in which mathematical terms must be kept to a minimum.

The induction field is not particularly valuable for purposes of communication because its extent is so limited, and bears a direct relationship to the frequency being used. It does mean, however, that the significance of aerial polar diagrams is not appreciated until the receiving point is some distance away, for although the various lobes and discontinuities are already developing close to the aerial, their definition is not great enough for any great variations in signal strength to be noticed at a near-by receiver.

Before going on to discuss directional aerial arrays, the matter of polarisation should be considered.

Radiation consists of the building up and collapsing of electric fields around the aerial, and it is obvious that the lines of force associated with these fields will bear a definite relationship to the plane in which the aerial is lying. In general terms, this relationship is called polarisation.

POLARISATION

It isn't important at the moment to analyse the exact make-up of what we have called the electric field, for this was covered to some extent in earlier discussion.

But it is important to recognise that this polarisation and its relationship to the aerial is fixed, and unless something happens during its path through space, the energy will arrive at the receiving aerial with the same polarisation as when it left the transmitting aerial.

For purposes of convenience, we consider radio waves leaving a horizontal aerial as being horizontally polarised, and those leaving a vertical aerial as vertically polarised.

It is fairly obvious that if we use a horizontal aerial for transmission, it is logical to use the same type of polarisation for receiving, for the wave-front will then have the best opportunity to excite the receiving aerial and cause currents to flow in it.

What can happen to the waves to change their polarisation? Anything which reflects them on their path through space can do this, if the reflecting plane is not at a suitable angle to avoid it. Waves reflected from the ionosphere, a notoriously unstable element, are often subject to polarisation changes, and in extreme cases they might even be changed through 90 degrees to arrive at the receiving aerial with a completely different polarisation.

Moreover, the change in polarisation can occur quite quickly and continuously, and has some effect on fading and distortion during fading. The longer the path taken by the signals, and particularly if multiple skips are involved between the ionosphere and ground, the more likely are changes of polarisation to take place.

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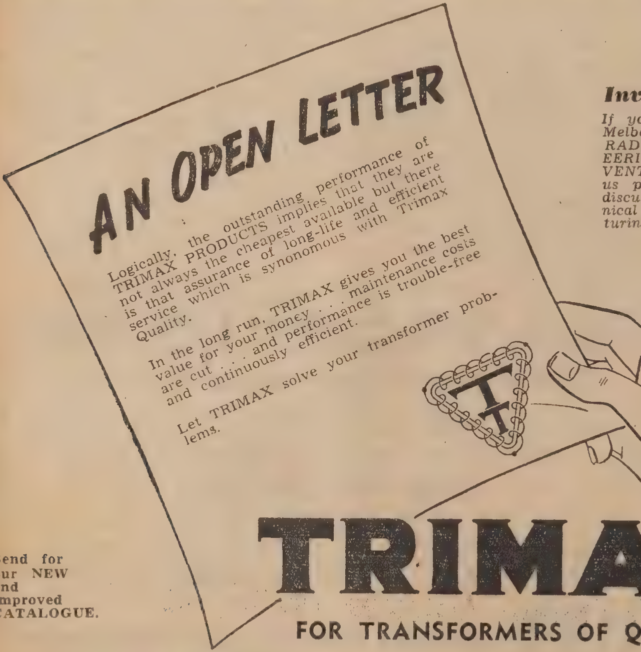

AN OPEN LETTER

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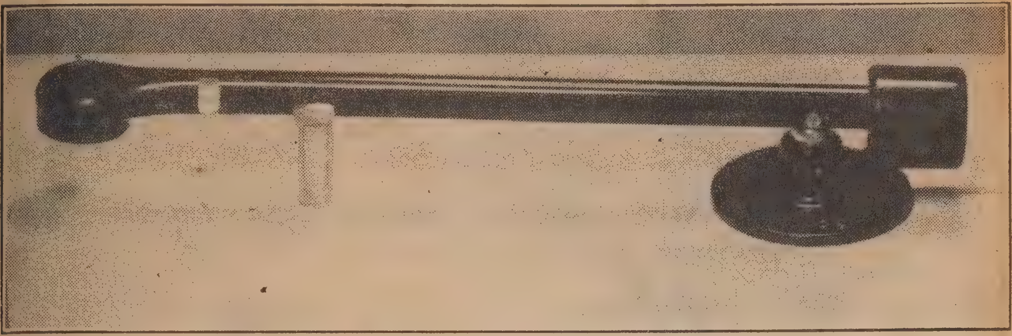
TRADE REVIEWS AND RELEASES



The Harris pickup. Both needle pressure and arm height are adjustable.

HIGH QUALITY HARRIS PICK-UP

The Harris pick-up, a moving iron type made in Australia, has always enjoyed a reputation for good performance. The latest model sent to us for test shows an improvement even on the high standard set by earlier models.

THE pick-up is most attractively finished in durable black enamel and is made to stand hard work. It is handsome and neat, and is a very easy pick-up to handle.

The heads are removable from the arm, being fitted with three pins which locate themselves in sockets fitted to the arm. Pressing the heads into place makes the necessary connections.

To remove them, a plunger in the arm above the heads is depressed, and eases them from their sockets.

They are normally fitted with replaceable sapphire points, but our test sample had diamond points which can now be supplied.

Stylus mounting is very light, and the tip automatically disappears into the head should it be dropped accidentally or subject to excessive pressure.

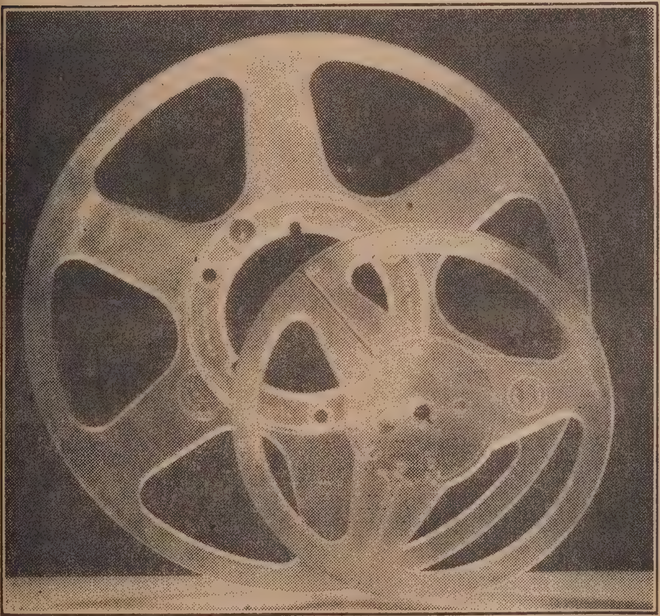
A coupling transformer is supplied giving an output of about 120 millivolts, but the pick-up will drive a standard Playmaster to good volume without it.

On test both frequency response and wave-form were exceptionally good. Peaks for both heads were well out of the useable range and their imminence scarcely detectable with standard test records. Intermodulation distortion was extremely low, and comparable with the highest quality pick-ups available.

The diamond tip should ensure years of service under normal conditions.

This pick-up is suitable for all types of home and transcription work where the highest performance is required.

PLASTIC TAPE REELS FROM BYER



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for speaker grills, etc.
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16 gauge .. ..
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Type TL10—complete with "point one" Pre Amplifier. 57gns.
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Pre Amplifier to match .. .. .. 19 gns.
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Magneto Phoneband, 1200ft.	67/4	1/3	2/3
Pyral, 1200ft. Plastic	69/-	1/3	2/3
Pyral, 1200ft. Paper	46/8	1/3	2/3
Splicing Tape, 66ft x ½in.	25/-	9d	9d
Splicing Tape, 66ft x 7/32	12/6	9d	9d
Byer Tape Splicer	22/9	9d	9d
7in Empty Spools	10/-	11d	11d
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ACOS HGP40, complete with 2 heads	£9/15/-	1/3	2/3
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DECCA Moving Iron, complete with 2 heads ..	£15/15/-	1/3	2/3
GOLDRING Variable Reluctance	£7/10/-	1/8	3/6
RONETTE Turn-over type	£7/9/1	1/3	2/3

MANTEL MAJOR
VITH LOOPSTICK

(Continued from Page 49)

ashers. This will provide room for its if they have to be used and low some space for any slightly cessive screw length.

Before finishing off this part of the b the control shaft should be cut a length which will enable the ntrol knob to fit neatly against the eaker grill. This is where the vantage of the countersunk screws ill be appreciated, since the round-ead types may foul the knob.

Wires from the control are carried one of the radial channels and are ought out from under the speaker filing a gap in the plastic flange which the speaker rests. A small t tail file is most convenient for is job which will only take a few inutes. The gap need not be large nce two lengths of hook-up wire, visted, are all that is required.

ONDENSER MOUNTING

The speaker may now be replaced id the circuit modifications cometed. The .02 mfd capacitor is most nveniently fitted to a terminal strip the speaker housing and this rangement avoids complications — articularly as regards servicing — hich would result if the leads were ken under the chassis. As it is, the tire tone control circuit is self-ntained with the speaker and does t affect the removal or fitting of e main chassis.

Incidentally, the speaker mounting rews were specified in last month's ticle as 3/16in diameter. This is correct, the right size being 5/32in.

To accommodate the capacitor the isting three terminal tag strip is placed by a seven terminal type. he two terminals each side of the rthed lug are used as before and e capacitor is mounted between e lower one and the last terminal the strip. To this terminal is con-ected one lead from the .1 meg pot., e other lead connecting to the ame of the speaker which should, turn, connect to the main chassis.

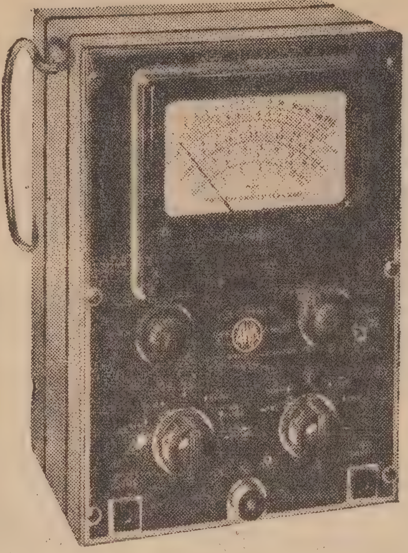
At this stage the set itself will eed to be modified slightly. In order give the control the greatest pos-ble range the fixed top cut form-ly fitted is no longer required and e .005 mfd capacitor from the late of the output valve to chassis ould be removed. However, some rm of RF by-pass is required in e interests of stability, and it should e replaced with a .001 mfd capacitor hich performs this function with-ut affecting the audio range.

VATCH CONNECTIONS

When connecting the two speaker ads from the chassis to the terminal rip it is essential that they be con-ected the right wav round, other-ise the tone control will not work. he lead from the plate of the out-ut valve must connect to the junct-n of the.02 mfd capacitor and the eaker transformer lead. Once this ad is identified it is a good idea to ark it in some way for future refer-nce.

The final result should be a mantel t having just about all the features ne could wish for. Self contained erial, tone control, good sensitivity, rge speaker with its obvious ad-antages, and all housed in a par-cularly attractive cabinet. On all ounts this set is going to be very ard to beat.

AWA VOLTOHMYST
A56010



WEIGHING ONLY 8½lb, this versatile instrument and its probes will measure all the voltages—r-f, a-f, a-c and d-c—to be found in normal communication, broadcast, or television equipment including the high voltages associated with the cathode ray tube. Further, the load imposed is so small that the voltages indicated are the real *working* voltages.

In addition, direct resistance measurements can be made on all the circuit components—coils, chokes, transformers, and resistors from low ohms to thousands of megohms — plus continuity checks and tests on condensers for leakage. D-C currents can also be measured directly.

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A-C Volts:	0.1 - 1500V (r.m.s. sinewave), 0.2 - 4200V (peak-to-peak) in 7 ranges, 30 cycles to 2.5 Mc; or up to 250 Mc. with crystal probe.
D-C Volts:	0.02 - 1500V in 7 ranges; or up to 30,000V with high voltage probe.
Resistance:	Up to 1000 M ohms, in 7 self-contained ranges.
Current:	0.02 - 1500 milliamps D.C., in 7 ranges.
Mains Supply:	240V, 50-60 cycles.

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BUYERS GUIDE 1955 PAGE ONE

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W.2, 2 piece standard, 6ft long	41/2
W.3, 3 piece, deluxe, 9ft long	53/4
COWL or SIDE Mounting.	
C.3, 3 piece standard, 9ft long	49/8
CD.3, 3 piece. One hole mtg. 9ft long	68/3
MUDGUARD or TOP COWL Mounting.	
CF.3, 3 piece swivel mount, 9ft long	74/7
BUMPER BAR Mounting.	
B.3, 3 piece, extends to 9ft.	87/-
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OUTSIDE Aerial Wire. Insulated. 80ft.	4/9
EGG INSULATORS	6d
LEAD IN STRIPS. Flexible type	6d
INDOOR AERIAL WIRE. Plastic. 20ft	1/9
AEGIS Loop Aerial with loading coil	22/9
R.C.S. Loop Aerial	10/-
AEGIS Ferroxcube Loop Stick	23/9
Q-Plus Ferroxcube Loop Stick	23/9
BRAMCO Ferroxcube Loop Stick	26/9

ALUMINIUM SHEET.

18 Gauge, medium hard. Polished.

6in x 6in	1/6	12in x 12in	6/-
6in x 8in	2/-	12in x 18in	9/-
8in x 12in	4/-	18in x 18in	13/9

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This is a high-grade 8-watt unit and is supplied complete with Rola or Jensen 12in speaker £31/15/-

Kits of parts are available for all popular amplifiers or we can build a special model to suit your requirements.

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Tenatone ¾in Bezel	4/6 ea.
Tenatone ¾in with lamp holder	6/8 ea.
Tenatone 3/8in Bezel	3/9 ea.
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R.C.S. Bobbins are ideal for winding special coil, etc.

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MO18 RF Choke Former	8d

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Polished black panel material.

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8in x 6in x 1/16in	2/-
12in x 8in x 1/8in	8/-

BATTERY CHARGERS.

S.T.C. 6 volt 4 amps	£9/15/-
S.T.C. 12 volt 3 amps	£10/10/-
S.T.C. 6 and 12 volt combined	£11/10/-

COIL FORMERS.

R.C.S. 1¼in 6 pin Plug-in	4/6
1½in 6 pin Plug-in	5/-
2¼in x 1¼in dia. poly tube	2/-
2¼in x 1½in dia. poly tube	2/-
Jabel 2in x ¾in dia. poly tube threaded 16 TPI	1/-
Brown Bakelite ¾in dia. per ft	1/-
2in dia. per ft	6/-

BATTERIES.

A complete range of EVEREADY DRY BATTERIES is always available and are guaranteed fresh stock.

BATTERY CLIPS.

Alligator	7d
10 Amp type	9d
25 Amp type	1/-
50 Amp type	1/6

NEW LINES

The following imported products have recently been added to our stocks:—

BELLING LEE CO-AXIAL CONNECTORS

A first-class fitting for up to 5/16in dia. cable. Polystrene insulation. Heavily silver-plated.

Plugs	3/3
Sockets	2/8

BELLING LEE TWIN FEEDER CONNECTORS

For 75 ohm lines. The 2-pin plug has a rubber grip and matching socket is high-grade bakelite.

Plugs	1/10
Sockets	10d

BULGIN INDICATOR BEZEL

A 3/8in jewel with plated ring fitted to adjustable lamp bracket. For MES type lamps 4/9

ARROW TOGGLE SWITCH

The best switch made. For panel mounting. Plated toggle and mounting nuts. Screw terminals.

SP/ST only 5/9

GELOSO MICROPHONES

T30 Hand or Desk type microphone, fully shielded with cord	72/-
UN10 Metal-cased crystal insert	30/7
409. Insert with rubber mtg. ring	32/11
M410. Insert with RF shield	38/6

CHOKES.

FILTER

National:—

12H. 50 mA.	11/6	30H. 80mA.	48/5
14H. 60 mA.	13/9	15H. 150 mA.	67/-
30H. 60 mA.	45/-	15H. 125 mA.	59/-
15H. 80 mA.	42/11	15H. 100 mA.	45/-

Ferguson:—

CF101. 30H. 25 mA.	28/5
CF102. 15H. 60 mA.	22/-
CF105. 15H. 80 mA.	42/-
CF106. 12H. 100 mA.	41/-
CF108. 12H. 150 mA.	64/-
CF110. 12H. 200 mA.	74/-
R.C.S. 14H. 60 mA.	10/-
Bramco. 12H. 50 mA.	10/6

Radio Frequency:—

R.C.S. 1 pye. 2.5 mH.	3/-
R.C.S. 3 pye. 1.7 mH.	5/6
R.C.S. 4 pye. 2.5 mH.	5/6
R.C.S. 5 pye. 4.0 mH.	5/6
R.C.S. 6 pye. 7.0 mH.	5/6
Aegis. C3. 4 pye, 2.5 mH.	5/9
Aegis. C2. 1 pye. 2.5 mH.	5/9
Q-Plus. RFC3. Iron Cored. 2.5 mH.	3/9
R.C.S. LT/RF Vibrator Choke	5/4

CRYSTAL SETS.

Q-Plus Crystal Set ready to use in attractive plastic case ('Phones and aerial not included.)	49/6
Radiomac Crystal Set Kit. Build it yourself, with instructions	40/-
Germanium Diodes. The best detector	10/6
Bramco Crystal Set Coils	3/9
Tenatone Semi-fixed detectors	9/-

CAPACITORS.

ELECTROLYTIC

400 mF.	12V Peak	5/
100 mF.	40V Peak	4/
25 mF.	40V Peak	3/
10 mF.	40V Peak	2/1
8 mF.	150V Peak	3/1
32 mF.	350V Peak	5/
24 mF.	350V Peak	5/
8 mF.	525V Peak	4/4
16 mF.	525V Peak	5/1
8 mF.	600V Peak	5/
16 mF.	600V Peak	6/1

Paper Tubular

0.001 mF.	600V Working	1/-
0.002 mF.	600V Working	1/-
0.005 mF.	600V Working	1/-
0.01 mF.	600V Working	1/-
0.02 mF.	600V Working	1/3
0.1 mF.	600V Working	1/5
0.25 mF.	600V Working	2/3
0.5 mF.	600V Working	3/2
0.05 mF.	400V Working	1/1
0.1 mF.	400V Working	1/4
0.25 mF.	400V Working	1/10
0.5 mF.	400V Working	3/-
0.1 mF.	200V Working	1/-
0.25 mF.	200V Working	1/9
0.5 mF.	200V Working	1/11

Minicap. Midget Tubular.

Size A. 3/16in x 7/16in:—		
0.004; 0.005 and .01 mF.	200V.)	1/-
0.001; 0.002; 0.003 mF.	400V.)	
2.5; 4; 10; 50; 100 pF.	600V.)	
200; 250; 300; 500 pF.	600V.)	
Size B. ¼in x 9/16in:—		
0.02; 0.03; 0.04 mF.	200V.)	1/1
0.005; 0.01 mF.	400V.)	
0.001; 0.002; 0.003 mF.	600V.)	
0.004 mF.	600V.)	

Mica

Standard types for 500VW:—

10; 50; 100 pF.)	1/-	0.001 mF.	2/-
200 pF. .. ..)		0.002 mF.	2/9
250 pF.	1/1	0.003 mF.	3/6
400 pF.	1/3	0.004 mF.	3/11
425 pF.	1/6	0.005 mF.	4/6
500 pF.	1/4	0.01 mF.	5/6

TRIMMERS: PADDERS ETC:—

Jabel Junior Trimmer, 3-30 pF.	1/-
Jabel Senior Trimmer, 3-30 pF.	1/5
Jabel 455 kc/s Padder	2/9
Jabel 2 Gang Trimmer	3/2
Jabel 3 Gang Trimmer	4/8
Jabel 4 Gang Trimmer	6/3
R.C.S. Trimmer, 3-30 pF.	1/3
R.C.S. 455 kc/s Padder	4/-
Philips Air Trimmer	3/3

R.C.S. MIDGET VARIABLES.

Capacity.	No. Plates.	
10 pF.	2	8/-
15 pF.	3	8/6
25 pF.	4	9/-
35 pF.	5	9/8
50 pF.	7	10/6
75 pF.	11	11/4
100 pF.	14	12/8

CEMENT, ETC.

Tarzan Grip	1/9
PC 49. A general purpose adhesive	2/11
R.C.S. Coil Lacquer	3/-

ELECTRICAL.

A comprehensive range of switches; plugs; sockets; connectors is available for all electrical uses.

PRICE'S RADIO

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AGE TWO

BUYERS GUIDE 1955

ABINETS.

range of Gibbon and Denham leatherte covered cabinets is available to suit e more popular Radio and Hobbies odels, including:—

ittle General	38/6
ew Fireside Five	50/6
ambler Portable	82/6
orta-Player	150/-
ecord Player Case	120/-
peaker Cabinet. 6in Standard	29/9
peaker Cabinet. 6in Deluxe	36/3
peaker Caibnet. 8in Deluxe	40/-
peaker Cabinet. 12in Deluxe	54/-
ultimeter Carrying Case	48/6
antel Minor	31/6
.P. Junior Amplifier	160/-
letal Case, 9in x 6½in x 5½in with panel and chassis. Brocade finish.	43/3
cope metal instrument case with sloping front. 12in x 8in x 8in.	42/3

ANG CONDENSERS.

(for broadcast band)

.W.A. Miniature, 2 gang	28/-
.W.A. Miniature, 3 gang	37/3
.W.A. Standard, 2 gang	27/5
.W.A. Standard, 3 gang	36/8
oblan Miniature, 1 gang	21/4
oblan Miniature, 2 gang	29/10
oblan Miniature, 3 gang	39/2
oblan Miniature, 2 gang with built-in vernier	35/11
abel Standard, 1 gang	21/4
abel tSandard, 2 gang	29/2
abel Standard 3 gang	39/6

Roblan & Jabel track with "H" dials.)

COILS, KITS, I.F. TRANS. etc.

AEGIS

tandard size in 1 3/8in dia. cans:—

M9 Broadcast Aerial	11/9
M10 Broadcast R.F.	11/9
M11 Broadcast Osc. (1R5 ECH35 6J8 EK2, etc.)	11/9
M11A Broadcast Osc. (1A7)	11/9
M11B Broadcast Osc. (6BE6)	11/9
M11D Broadcast Osc. (6AN7)	11/9
9 I.F. Trans No. 1 455 kc/s	15/3
10 I.F. Trans No. 2 455 kc/s	15/3
20 I.F. 455 kc/s medium select No. 1 and 2	22/6
21 No. 3 to be used with J20	22/6
24 I.F. Trans 10.7 mc/s	36/3
25 Ratio Detector 10.7 mc/s	42/3

Miniature types ¾in square cans:—

M24 Broadcast Aerial	13/11
M25 Broadcast R.F.	13/11
M26A Broadcast Osc. (6AN7)	13/11
M26B Broadcast Osc. (6BE6)	13/11
M26C Broadcast Osc. (1R5)	13/11
M26D Broadcast Osc. (6AE8)	13/11
30 I.F. Trans No. 1 455 kc/s	20/9
31 I.F. Trans No. 2 455 kc/s (J30/31 for 1.4V valves)	20/9
32 I.F. Trans No. 1 455 kc/s	20/9
33 I.F. Trans No. 2 455 kc/s	20/9
ar Radio Coil Kit for R & H 5 valve, with high gain aerial coil	77/6

Miscellaneous Coils:—

M16 B.F.O. 455 kc/s	15/-
M22 Crystal Filter In. 455 kc/s	18/10

BRAMCO Miniature broadcast coils in ¾in square cans. Iron Clad.

MA2 Aerial	11/9
MRF2 R.F.	11/9
MO2 Oscillator (1R5)	11/3
MO3 Oscillator (6AN7/6J8, etc.)	11/3
MO4 Oscillator (6BE6)	11/3
MO1 Oscillator Unshielded (1R5)	5/9
MIF1/2.455 kc/s IF Trans 1 & 2	17/3
Car Radio Coil Kit for Radio and Hobbies 5-valve Karset	72/6
Miniature Dual Wave Bracket	62/6

RADIOMAC SCALES & NAME PLATES.

These high grade plates are available exculsively from Price's Radio. They are finished Nickle on black and improve the appearance of any equipment.

Condenser Scale 2¾in dia.	2/-
Condenser Scale 2 in dia.	1/6
Condenser Scale 1¾in x 1¾in	1/6
Volume Control Scale, 1¾ x 1¾	1/6
Volume Control Scale 2¼in x 1¾in	1/6

Name Plates 1¼in x ¼in in the following titles are available: —

AC. DC.
Adjust
Aerial
Amplifier
Amplitude
Attenuator
Band Spread
Broadcast
Bass
Course
Earth
External
Fine
Focus
Gain
High
Input
240V AC.
Intensity
Internal
Low
Microphone
Milliamps
Modulation
Off-On
Ohms
Oscillator
Output
Phones
Pickup
Play Back
Radio
Receiver
Record
Regeneration
50 cps.
Selector
Short Wave
Speaker
Stand By
Sweep
Sync.
Tone
Treble
Tuner
Volts
Volume
Wave Change
X Amp
X Plate
X Shift
Y Amp
Y Plate
Y Shift

6d ea.

AEGIS

M22A Crystal Filter Out 455 kc/s	18/10
M23 C.R.O. Coil for 2000V HF supply	13/3
Whistle Filter Coil	14/6

Short Wave Coils:—

H4 Aerial Permatune 13-42 Metres	10/9
H5 R.F. Permatune 13-42 Metres	10/9
H6 Osc. Permatune 13-42 Metres	10/9

R.C.S. Standard size 1 3/8in dia. cans:—

Aerial Coil	10/2
R.F. Coil	10/2
Oscillator Coil	10/2
Reinartz Coil	10/2
I.F. Trans. No. 1 and No. 2	16/6
I.F. Transformers Low Gain	20/-
I.F. Trans. with Reaction	30/-

(The above are for broadcast band and 455 kc/s intermediate frequency)

Q-PLUS.

As well as the standard type, the following are available:—

RC.9. Untuned RF or 16 mH. RFC.	4/9
IF12/13. Midget 1600 kc IFT.	19/10
IF12A. Midget 1600 kc. Broad Band	19/10
DW.4. Dual Wave Unit for 6A8, etc.	58/4
DW.5. Dual Wave Unit for 6AN7, etc.	58/4
DW6. Dual Wave Unit for 1R5	62/3
DWR.4. as DW.4 with RF stage	109/-
DWR.5. as DW.5 with RF stage	109/-
DWR.6. as DW.6 wtih RF stage	124/6
WFC.1. Whistle Filter 10 kc/s	8/6

DIALS.

The following Efco dials are complete with escutcheon and lamp fittings ahd are available with AWA or "H" calibrations.

MK17A. Kit dial, cord drive. Scale 2¾in x 2¼in. (Also 0-100)	17/2
USL/32A. Cord drive. Straight line. Scale 6½in x 3½in	42/4
USL/37G. Cord drive. Straight line. Scale 5in x 1¾in	37/2
SLV/21. Cord drive. Vertical straight line. Scale 2½in x 3½in.	37/2
USL/44. Cord drive. Straight line. Scale 5in x 3½in	40/8
MSL/48. Straight line for Car radio. Scale 3⅜in x 1⅛in	35/-
SLV/45. Cord drive. Vertical straight line. Scale 3½in x 5in	39/4
USL/46. Cord drive. Straight line. Scale 9¼in x 4¼in	54/8
USL/51. As USL/46 but cream scale background	64/8
USL50. Cord drive. Straight line. Scale 8in x 8in	54/2

Replacement glass scales are available for the above dials.

GLOBES, LAMPS, etc.

A complete range of household globes, ornamental and decorative lamps, Fluorescent tubes and Automobile lamps is available.

Dial Globes. 6.3V M.E.S.	1/-
Dial Globes. 2.5V M.E.S.	1/-
Dial Globes. 6.3V M.B.C.	1/3
Torch Globes. 2.5 and 3.8V	7d
Torch Globes. 1.1V	1/-
Torch Globes. 6V	7d
Torch Globes. 2.5V Prefocus	1/3
Cycle Globes. 6V. 0.45A.	1/3
Neon Indicator. Miniature 80V.	3/9
Neon Indicator. Mounted. 240V.	9/-

HEADPHONES.

Brown type "X" A lightweight. 2000 ohms headset. Ideal for crystal set	55/-
Brown type "F". A featherweight 4000 ohms Professional head set	77/9
Erpees. A good quality imported headphone set. 2000 ohms	26/-

KNOBS.

	Brown.	White.
Fluted ¾in dia.	9d	1/-
Fluted 1in dia.	1/-	1/3
Knurled 1½in dia.	2/-	2/-
G.R. type. Fluted 2½in dia. Black		10/-
As above with 3in skirt. Black		10/6
G.R. type. Fluted 1 1/8in dia. Black		2/3
Pointer Knob, 1¼in long. Black		1/-

TUNING UNITS.

Q-PLUS. PRE-FAB. TUNING UNITS.

Complete front ends—wired aligned sealed. Come complete with gang condensers, valve sockets, etc. Simply add valves ½ IF and audio stage. All include RF stage.

DWRP-5. Dual Wave BC and 16-50M.	£14/14/-
TWRP-5. Triple Wave. BC 2.8/8.0 and 7.3/23 mcs	£15/18/-
QWRP-5. Band Spread on 31, 25 and 19 metres plus BC.	£17/3/-

PRICE'S RADIO

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PAGE THREE

CHASSIS

A large range of recent Radio & Hobbies chassis, and some of the popular older types are available from stock. (Other models, delivery in 14 days.) A few types only are listed:—

Williamson Amplifier	18/-
Simplified Super, 5V AC	19/6
Little General 1952	15/6
Playmaster Amplifier, No. 1 & 2	18/6
Playmaster Amplifier, No. 6 & 7	15/9
Playmaster Tuner, No. 2	15/9
Karset, 1952, 5V. Complete	55/-
Karset, 1953. 4V. Complete	42/9
Rambler Portable	13/9
Portaplayer	20/6
Instrument Case with chassis	43/3

GRAMO MOTORS

Collaro 3 Speed Player unit with high fidelity pickup	£11/15/-
Collaro 3 Speed Record Changer. An excellent trouble-free model	£19/17/6
Garrard 3 Speed Record Changer with turnover pickup	£20/10/-

MICROPHONES

Ronette B1108. Plastic Torpedo	79/7
HM7. Filtercell. Diecast, for hand or stand use	143/6
BDX Crystal Head	35/-

Geloso—see list under "New Lines".

Amphenol. Chassis socket connector	6/1
Plug for above	7/11

POTENTIOMETERS

I.R.C. Wire-wound in—10; 30; 100; 300; 500; 1000; 2500; 5000 and 10,000 ohms	10/6
I.R.C. Carbon type in 100; 500; 1000; 2500; 5000 ohms; 0.01; 0.025; 0.05; 0.1; 0.25; 0.5 and 1.0 megohms	7/-
I.R.C. Switch Pots, 0.5 and 1.0 megohms	12/8
Morganite. Switch Pots. DP.DT in 0.5 and 1.0 meg.	10/6

PICK-UPS

Goldring No. 137 Magnetic, 78 RPM.	49/6
Goldring No. 500 Variable Reluctance. High Fidelity for 78 and L.P. Recordings	£7/10/-
Goldring No. 500, head only	£5/5/-
Acos, HGP 40 High Fidelity with 2 interchangeable heads	£9/15/-
Acos, HGP 38 High Fidelity with turn over head	£5/15/-
Acos, GP20 Microcell type with two heads	£7/19/6
Acos, GP30. Standard turn over type	£4/17/6
Acos, HGP39 Heads (for HGP40)	£3/12/6
Acos. HGP37 Cartridge (for HGP38)	£3/17/6
Acos, GP19 Heads (for GP20)	£2/18/6
Acos, GP29 Cartridge (for GP30)	£2/10/-
Acos, GP9 Cartridge for old types	£1/11/6

Ronette. See under "New Lines".

Replacement sapphire styli for all popular pickups available, from	12/6

JACKS & PLUGS

Aegis Phone Plugs	5/9
Aegis Open Ckt. Jack	4/9
Aegis Closed Ckt. Jack	6/-

RESISTORS

A complete range of I.R.C. Resistors is available both in metallised and wire-wound types, from ½ to 20 watts.

Larger ratings are available to order.

½ Watt, types BTS, BT½ and BW½	9d
1 Watt, types BTA, BT1 and BW1	1/-
2 Watt, type BT2	2/-
3 Watt, type AA Wire-wound	2/7
5 Watt, type AB Wire-wound	3/3
20 Watt, type DG Wire-wound, from	5/10

NEW LINES

Further new products recently added to our stocks:—

PHILIPS GANG CONDENSERS

At last a miniature gang which is a quality product. Pressed one piece frame Brass plates, ball bearing and ceramic bead insulation. Max. cap. 410 pF.

2 GANG, 1 7/8in x 1¾in x 1 7/8in.	26/4
3 GANG, 1 7/8in x 1¾in x 2¾in.	34/5

SCOTCH TAPE REELS.

To take 1200ft tape	10/-
To take 600ft tape	8/-

UNIVERSITY PLUGS & SOCKETS

First Quality Plug. Red or Black	9d
Insulated sockets to suit	11d

NEON TEST PENCILS

Ideal for checking 240V mains, etc.	16/-

RONETTE PICKUPS

The Ronette, in our opinion, is the best crystal pickup to be offered to the public. A slender chrome arm with cream plastic base and head, fitted with a turnover unit	£7/9/1
Ronette "O" cartridge standard	£2/12/-
Ronette "P" cartridge professional	£2/12/-

SOLDERING IRONS

ELFO Standard 240V 60-watt with cord	42/6
Scope, 6 second Iron for 4 to 6-volt operation	50/-
Scope Transformer for using Scope Iron on 240V AC	47/11
Oryx. A real miniature Iron for 6V operation, 12W.	55/-

SPAGHETTI

Cambric Varnished	1mm, yd.	5d
Cambric Varnished	1½mm, yd.	6d
Cambric Varnished	2mm, yd.	7d
Cambric Varnished	4mm, yd.	10d
Plastic Sleeving	1mm, yd.	1½d
Plastic Sleeving	2mm, yd.	3d
Plastic Sleeving	4mm, yd.	5d
Plastic Sleeving	6mm, yd.	7d
Plastic Sleeving	10mm, yd.	1/-

VIBRATOR CARTRIDGES

V5105.	Non-sync.	4-pin.	6V	32/3
V5123.	Non-sync.	4-pin.	12V	33/5
V5124.	Sync.	6-pin.	6V	39/11
V5258.	Sync.	6-pin.	12V	39/11
V5211.	Split Reed,	7-pin.	6V	42/11
V5984.	Split Reed,	7-pin,	12V	49/8

Other types and voltages to 32V available to order.

VOLTAGE DIVIDERS

R.C.S. 25,000 or 15,000 ohms	8/-

SPEAKERS

(Complete with trans.)

JENSEN.

3PX	3½in PM.	37/9
4PW	4in PM.	39/2
525PW	5¼in PM.	41/1
6PU	6in PM.	53/8
7PT	7in PM.	60/7
96PU	9in x 6in PM.	63/5
12PU	12in PM. (3 ohm VC)	68/9
12PS	12in PM. (6.5 ohm VC)	92/9
12PQ	12in PM. (12.5 ohm VC)	136/11
5E12	5in EM. (1500 ohm field)	48/1
6E30	6½in EM. (1000 ohm field)	59/-
7E12	7in EM. (1500 ohm field)	68/7
7E13	7in EM. (1000 ohm field)	68/7
12E30	12in EM. (1500 ohm field)	106/7

ROLA

3C	3in PM. (E Trans)	38/2
5B	5in PM. (L Trans)	33/7
5F	5in PM. (D Trans)	50/8
6H	6in PM. (D Trans)	52/2
6L	6in PM. (D Trans)	65/11
8K	8in PM. (C Trans)	60/3
8M	8in PM. (C Trans)	71/11
12M	12in PM. (C Trans)	86/9
12-O	12in PM. (C Trans)	110/9
12-O	12in PM. De Luxe. (No Trans)	102/10
12-OX	12in PM. (No Trans)	174/10
12U	12in PM. (No Trans)	£16/10/10

Whilst a large range of speakers are stocked, we cannot guarantee to be able to give immediate delivery of any one model.

SPEAKER TRANSFORMERS

Jensen.	
"XJ" for 3in model	11/1
"XA" for all except 12PS: 12PQ and 12E30	11/9
"TU" for 12PS and 12E30	21/11
"TX" for 12PK	25/5
Rola.	
"C"	21/7
"D"	17/6
"E" and "F"	16/-
"L"	15/5
Bramco replacement for all small Rola and Jensen	12/6

EXTENSION SPEAKERS

Aegis Junior. Plastic Case complete with 5in speaker. Brown or Black .. 45/. White	47/6

BRAMCO SPEAKER WINDINGS

A type to suit all speakers. 2500; 5000; 7000; 10,000 and 15,000 ohms impedance.	7/3

Please advise make and model of speaker when ordering.

TOOLS

HOME UTILITY. Quality products manufactured by Black & Decker.

Utility Electric Drill, ¼in	£11/15/3
Orbital Sander	£24/2/3
Vertical Drill Stand, ¼in	£7/-/-
Horizontal Drill Stand, ¼in	£1/14/3
Sanding and Polishing Kit	£2/1/-
Grinding and Buffing Kit	£1/13/6
Abrasive Kit	£1/13/3

VALVES

A comprehensive range of valves is available, both local and imported, including many old and difficult to secure types.

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WITCHES.

abel Miniature Wafer:—1 pole, 12 position; 2 pole, 6 position; 3 pole, 3 position; 4 pole, 3 position	9/9

ak Wafer types:—

pole,	11 position,	1 bank	11/2
		2 ,,	18/3
		3 ,,	25/-
,,	12 ,,	1 ,,	13/3
		2 ,,	22/11
		3 ,,	30/11
,,	4 ,,	1 ,,	10/10
		2 ,,	17/5
		3 ,,	23/10
,,	5 ,,	1 ,,	10/10
		2 ,,	17/5
		3 ,,	23/10
,,	3 ,,	1 ,,	10/10
		2 ,,	17/5
		3 ,,	23/10
,,	2 ,,	1 ,,	10/10
		2 ,,	17/5
		3 ,,	23/10
,,	2 ,,	1 ,,	13/3
		2 ,,	22/11
		3 ,,	30/11

Alpha. (Suitable for 240V AC).

Type A. SP, DT. Toggle	7/2
,, D. DP, ST. ,,	10/10
,, F. DP, DT. ,,	13/8
,, C. SP, DT. Rotary	8/10
,, E. DP, ST. ,,	13/8
,, G. DP, DT. ,,	15/10

TEST EQUIPMENT Meters, etc.

University:—

DCM. DC Multimeter	£10/13/9
ACM. AC/DC Multimeter	£14/1/3
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MK1. AC/DC Multimeter Kit, for home assembly. Full instructions and diagrams supplied	£12/7/6
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YOA. AC Test Oscillator	£40/10/-
YOB. Battery Test Oscillator	£40/10/-
TST. Valve and Set Tester AC/Vib.	£63/-/-
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The above power transformers have normal filament windings and are available either for horizontal or vertical mounting. HT of 325 and 385 are also available.

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PF130. 285/285V at 100 mA	66/-
PF174. 285/285V at 150 mA	87/9
PF140. 385/385V at 200 mA	158/8
PF173. 425/425V at 175 mA	169/6

The above include filament windings.

Vibrator Transformers:—

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VT102. 6V to 150V at 25 mA	39/11
VT127. 6V to 200V at 60 mA	44/-
VT107. 6V to 250V at 60 mA	47/-
VT132. 12V to 200V at 60 mA	44/6
VT117. 12V to 250V at 60 mA	47/7

Output Transformers:—

OP24. 5 watts. 5000 SE to 8.4 or 2.1 ohms	74/3
OP25/8. 15 watts. 10,000 CT to 8.4 or 2.1 ohms	225/-
OP25/15. 15 watts. 10,000 CT to 15 or 3.7 ohms	225/-
OP54. 10 watts. 5000/2500 to 15/12/8/6/4/3/2.7/2.3/2 ohms	79/6
OP58. 15 watts. 10,000/6600/5000 to 15/12/8/6/4/3/2.7/2.3/2 ohms	117/9
OP112. 6 watts for Rola 120X. 10,000 CT to 8 or 2 ohms	101/3
OP113. 6 watts for Rola 120X. 5000 SE to 8 or 2 ohms	101/3

The above are preferred types but other wattages and impedances can be supplied

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2in long.	Doz.	2/-
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8 lugs	Ea.	9d
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Panels 12in, 24 pairs lugs		4/6
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Teletron Mini 7-pin and Shield	5/2
Teletron Noval. Black	1/3
Teletron Noval. Mica	1/9
Teletron Noval and Shield	9/9
Aegis Ceramic Acorn	6/3
Aegis Ceramic Octal	6/3
Teletron Mini 4-pin Socket	9½d
Teletron Mini 4-pin Plug	10½d
Amphenol Plugs: 4, 5 and 6-pin	1/3
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TYPE 920 — 15 watts.
Prim.: 5000, 3000 ohms P.P.
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TYPE 897 — 15 watts.
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Sec.: 500, 250, 166, 125 and 100 ohms.

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OUTPUT TYPE

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(for "Rola" 120X).

TYPE 871 — 12 watts.
Prim.: 10000 ohms P.P.
Sec.: 2 or 8 ohms.

TYPE 872 — 12 watts.
Prim.: 10000 ohms P.P.
Sec.: 3.7 or 15 ohms.

ULTRA-LINEAR OUTPUT

TYPE 931-15: 20 watts.
Prim.: 4500 ohms P.P.
Sec.: 3.7 or 15 ohms.
Resp.: 10-60000 cps.
Valve: EL37, KT66, 6L6, etc.

TYPE 931-8: 20 watts.
Prim.: As 931-15.
Sec.: 2 or 8 ohms.
Resp.: As 931-15.
Valves: As 931-15.

TYPE 921-15: 20 watts.
Prim.: 6600 ohms P.P.
Sec.: 3.7 or 15 ohms.
Resp.: 10-60000 cps.
Valves: 807, KT66, etc.

TYPE 921-8: 20 watts.
Prim.: As 921-15.
Sec.: 2 or 8 ohms.
Resp.: As 921-15.
Valves: As 921-15.

TYPE 916-15: 12 watts.
Prim.: 8500 ohms P.P.
Sec.: 3.7 or 15 ohms.
Resp.: 10-50000 cps.
Valves: 6BW6, 6V6, KT61, etc.

TYPE 916-8: 12 watts.
Prim.: As 916-15.
Sec.: 2 or 8 ohms.
Resp. As 916-15.
Valves: As 916-15.

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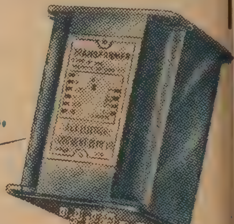

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LOOK FOR THE SILVER-GREY TRANSFORMER

A READER BUILT IT!

Gadgets and circuits which we have not actually tried out, but published for the general interest of beginners and experimenters.

Mobile radio equipment for bush fire and other emergency services is of particular interest to country readers and this article describes a Walkie Talkie type unit designed and built for a bush fire organisation by Mr. J. T. Baker, "Grand View", Warburton, Victoria.

HE unit was designed to provide communication between a ground rty—often operating in thick scrub and the party's mobile truck which uld, in turn, be in communica- n with the base station. Thus a ssage can be passed quickly from ground party to the base, even ugh the latter is out of direct ge of the portable transmitter.

Our contributor claims a range of o to three miles for the transtter while the receiver has reved signals from over 300 miles ay. These results were obtained ing an 8ft steel whip aerial which designed to be removed when the it is being carried. Doubtless ch greater range would be posle if used in conjunction with a sonant aerial, though this is seldom actical unless an emergency base to be established.

ANDARD VALVES

As can be seen from the circuit unit uses standard battery-type ceiving valves and may be regard- basically, as a standard fourve battery receiver which may be nverted to a transmitter by means a series of switched circuits. The ception is the lower 3V4 which erates as a modulator and is reired for transmission only.

When switched to the transmit sition the loudspeaker operates as microphone, the 1S5 as a voltage amplifier, the lower 3V4 as a modulator and the other 3V4 (normally the receiver output valve) as a crystal controlled oscillator.

The whole unit, including Mini-Max batteries, is built into a discarded personal portable case measuring 8¾in by 4in by 3½in. All the tuning controls are in the form of slotted shafts for screwdriver operation and these are set below the level of the case.

Both the receiver and transmitter tuned circuits are brought close to resonance by means of fixed mica capacitors and are then finally tuned by means of small capacitance butterfly capacitors.

The coil details are as follows:—Receiver aerial: Primary, 10 turns 33g. Secondary, 24 turns 26g. The primary is wound over the lower end of the secondary. Receiver oscillator: Primary, 12 turns 33g. Secondary: 22 turns 26g. Primary is wound below secondary. The transmitter tank coil consists of 30 turns of 24g wire wound on a 1¼in former. Taps are at one quarter, one third, and one half the number of turns frc n the bottom.

The HT current drain, using nine volts bias, is 6mA for receiving and 15mA for transmitting. The filament drain is 350mA for both condtiions. A suggestion in regard to this latter is that it might be possible to arrange an extra switch pole to open the filament circuit of the modulator valve when the set is in the "receive" position. This would save 100mA of filament current during standby periods.

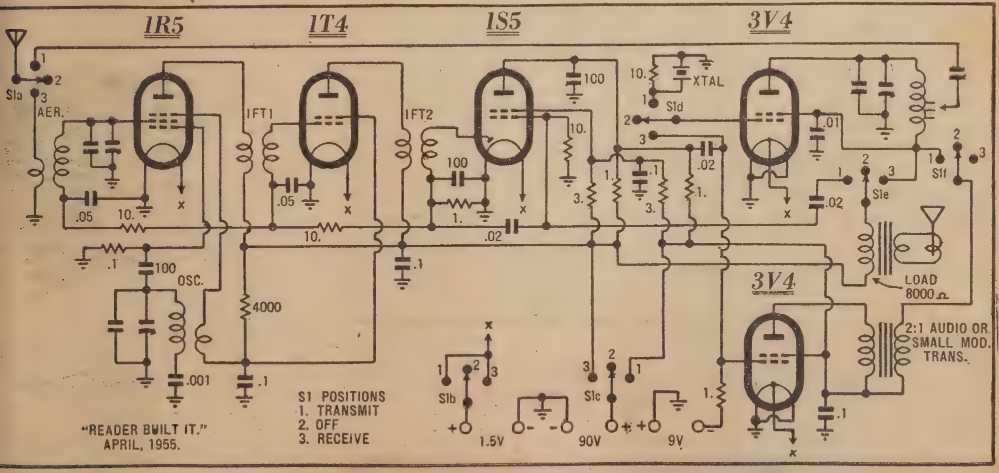
In any case Mr. Baker is inclined to recommend larger batteries than the very small personal portable type unless extreme portability is a major consideration, since the life of these batteries is poor under these conditions.

This is not surprising, since these batteries are not intended for the heavy drain imposed on them by the transmitter and much more economical operation would be obtained from a larger size. These could be accommodated either in a larger main case or carried in a separate case and plugged in when required.

NO V. CONTROL

The original model was not fitted with a receiver volume control, it being difficult to fit in the available space. It is claimed that this is seldom required in practice except when very close to a transmitter. However, it could be fitted if desired, the diode load being probably the most convenient position for it.

The original unit was designed for operation on 4440 Kc, this being the frequency allocated to the particular organisation. Naturally other units will have to be modified slightly to set them to the frequency allocated by the PMG's department. Fortunately it should be a fairly simple matter to alter the receiver and transmitter coils to the assigned frequency, while the crytsal will naturally need to be made to order.



Here is the circuit exactly as submitted by Mr. Baker. The 10 meg. AVC resistors could well be reduced to 1 or 2 megohms.

Let's Buy An Argument

by Neville Williams

Having completed the previous instalment of this feature and performed the sundry other duties involved in getting the last issue to press, I turned my attention to the rather formidable pile of correspondence which had collected. In it was a letter which, had it been posted a few days earlier, would have been a natural one to include.

HOWEVER, this is one case where the old saying applies "Better late than never".

The letter in question has been reproduced on the opposite page and I suggest that you proceed forthwith to read it. The writer has quite a deal to say about the Ultra-Linear circuit, which he rates as "rather pointless".

I take it that, in the meantime, he will have read the "Argument" article in the last issue, which was actually in type by the time his letter was penned.

SHOULD FEEL HAPPIER!

I trust that it will have allayed his disappointment somewhat to realise that we had indeed considered the operation of the circuit pretty carefully. Many of the points which were mentioned in an earlier issue by the Editor were examined at length in the "Argument" article—and they are the same points which our correspondent now raises.

We talked about input impedance, the effects of screen feedback, the reasons for power limitation and the possibilities of achieving the same kind of result with alternative circuit arrangements. We even suggested that the cathode feedback scheme might be a better one in terms of ultimate performance.

That should have made A.H.F. very happy!

However, we are not willing to dismiss the Ultra-Linear circuit quite as airily as our correspondent has done. While not falling for "ballyhoo" as he feared, we are nevertheless aware that the idea may have certain attractions and offer certain economies in design. Nor are we alone in this opinion.

Perhaps the logical course is to run through A.H.F.'s letter point b point and see to what extent w agree or disagree.

(1) In general terms we agre with this statement. Screen powe considerations, either input or output, are probably not very significant when related to the total powe in the plate circuit.

(2) Troublesome phase rotatio stemming from the output transformer and load, can occur whethe the feedback is taken from the whol primary, a tapping thereon, from th secondary or from a special tertiar winding. Each method has its goo and bad features.

I know of no fundamental or decisive reason why screen feedbac should represent a greater hazar than other minor loops around th output stage.

A large proportion of our testin has been directed to the observatio of effects in the supersonic regio and we have specifically been or the lookout for actual instability for bumps in the response curve o for "ringing" effects with high frequency square-wave input.

Having made such observation on several amplifiers, several set of output valves, triode, pentode an UL-connected, and with a larg number of output transformers, w have been left with the general impression that the Ultra-Linear circuit is a very docile one.

After all, "the proof of the pudding . . ." &c.

(3) We agree that the circuit must be regarded primarily as a feedback loop around the output stage. Whether or not it is a convenient circuit to use, will depend on circumstances. More about this anon.

SAME CONCLUSIONS

(4) We examined the reasons, last month, for the normally reduced power output with the Ultra-Linear connection. Our diagram (Fig. 1) on page 71 tallies exactly with A.H.F.'s explanation. His observations about the EL37 are interesting and probably quite valid.

(5) Again we are in agreement. The Ultra-Linear connection does not appear to affect input resistance as such, only input capacitance.

His second statement about feedback to the grid affecting input impedance is perfectly true, but what difficulties are hidden by his obseration that it has “to be allowed for n the design of the driver stage”.

The need “to allow for it” is, to my mind, a very potent argument for either screen or cathode feedback!

The reduced input impedance is self something of a hazard, because markedly lowers the AC/DC load atio on the driver valves.

OMPLETE SYMMETRY

But, assuming that this difficulty an be overcome, a completely symmetrical feedback system is only ossible to symmetrical plate circuits delivering exactly balanced rive. This eliminates what are at resent the two most popular inerter-drivers and leads to added complexity in the front end.

There may be a way around the ifficulty, but there is more to it than A.H.F. would seemingly have s believe.

(6) The Ultra-Linear transformers we have handled have, for the most art, been adapted from routine igh-fidelity designs, as already marketed by a variety of manufacturers. As such, the transformers already incorporate sufficient high-uality iron to allow adequate inuctance and sufficient inter-windng to ensure good high frequency haracteristics.

No special or additional interwinding has been used, the screen tapping being taken in many cases rom a convenient junction between he sections. Presumably, the manufacturers have been quite happy with the natural symmetry which can be obtained in this way and he intimacy of coupling between ll sections.

They seem to regard the inclusion of a tapping at a suitable ratio s a simple modification, which adds very little to the cost of production.

In other words, there seems to be no practical evidence to suggest that the addition of screen tappings either complicates the design or sensibly degrades the performance of conventional high-grade transformers.

(7) We agree and we have already mentioned this point, even to the coincidental use of the same adective.

COMPLICATED ANYWAY?

However, even if the circuit does become rather “messy” in using certain valves and operating conditions, it must not be forgotten that a certain amount of “mess” elsewhere in the circuit may be involved in achieving the same results by other means.

So much for the specifically numbered paragraphs in A.H.F.'s letter. Now for some general comment.

An amplifier always tends to behave better when the output valves have a low effective plate impedance. The output voltage does not vary so markedly with variations in load and/or transformer impedance, while energy fed back into the valves from the load side is more effectively dissipated or “damped”.

The amplifier is less sensitive to resonance effects in the output circuit—whether actual or virtual—and therefore less likely to exhibit damped oscillation or “ringing” under strenuous signal input conditions.

The use of low-impedance triode type output valves achieves these results as a matter of course. Conversely, by the application of voltage negative feedback to pentodes (or tetrodes) it is possible to lower their apparent output impedance, with rather similar results.

Hence the recent popularity of both arrangements.

However, the use of feedback is attended by certain difficulties, which must be considered if one is going to be fussy about ultimate details.

Chief among these difficulties is that of phase rotation at extreme frequencies. Due to the reactive nature of the output transformer and load, and to possible leakage inductance, the feedback voltage does vary in phase from its intended relationship to the input signal.

The more stages over which the feedback operates, the more chance there is of additional phase shift occurring between the input and feedback voltages. As a result, an amplifier which may be designed for a precise 15db of feedback at middle frequencies may prove to have much less effective feedback in a particular supersonic region.

The rise in gain which such phase rotation promotes may be sufficient to more than offset natural losses elsewhere in the amplifier and lead

HE DOESN'T LIKE ULTRA-LINEAR

I am rather disappointed to find that you devoted so much space to a description of the “Ultra Linear” amplifier, as it is in reality a rather pointless circuit. I can only assume you have been misled by the ballyhoo which has been written about it.

It is essentially nothing more than the provision of a second feedback loop from the plate to the screen of the output tubes. This feedback is different only in minor details from feedback to the control grid. The main variations are:

(1) The screen grid draws current and must be regarded as an active element. It is true, as you say, that in this circuit the screen contributes power but only to an insignificant degree. With 25 pc tappings the screen voltage swing is 25 pc of plate voltage swing and the current swing is 25 pc (about) of the standing screen current. Obviously the amount of power delivered is less than 1 pc of the power from the anode circuit. The screen current may be important if the transformer is not perfect.

(2) Because the screen feedback is provided by a transformer, there is a possibility of unwanted phase shift in the feedback path especially at high frequencies. Obviously, in your tests, it has not been sufficient to cause difficulties but it could help to make the main feedback loop oscillate.

(3) To a first approximation, a change of voltage V on the screen is equivalent to a change of control grid voltage of V/Vt. To the extent that the triode mu of the valve is constant, control grid or screen grid feedback will produce identical results. The triode mu does not vary greatly over the range of conditions met with in this kind of operation and it is hard to see if the screen grid is better or worse. In any case the difference will be very slight and quite overshadowed by the next factor.

(4) At the negative extreme of plate voltage swing, the screen is also at a lower voltage than the screen supply. This limits the plate current at this point (if no grid current is to flow) and thus limits the available output. This is the basic reason for the limitation of output power with “Ultra-Linear” operation. (The EL37 is an unusual type, designed for a specific purpose, and I suspect that under the conditions of pentode operation the grid swing is rather less than the working bias.)

(5) The “Ultra-Linear” connection has no effect on the input impedance of the valve (except the Miller effect capacity you noticed). Feedback to the grid, however will affect input impedance, and this would have to be allowed for in the design of the driver stage.

(6) It is difficult enough to design a good output transformer without tappings. The addition of taps must degrade its performance.

(7) Without rather messy arrangements it is impossible to use a different potential on the screens. This is quite an important point if really high power is needed.

The improved frequency response of the amplifier, with or without feedback, is easily explained by the reduced output impedance of the valves with negative feedback. The same result would be obtained by any other auxiliary feedback loop.

The difference between the EL37 and 6L6 is probably because the EL37 is a pentode and the 6L6 is a tetrode with a very sharp knee, and very clearly defined overload. The EL37 would not show such a pronounced overload in a pentode connection, but its output for reasonable distortion would probably be below the actual overload point (the point where a clearly defined change in operating conditions occurs).

To sum up it is certain that the circuit offers no advantage over a circuit with a feedback loop to the plates of the 6SN7 tube (about 6-8db feedback) and overall feedback from the transformer secondary to the input. This alternative circuit would be cheaper, and have increased power output, and allow 6L6's to be used if desired, without the adverse effects of “Ultra-Linear” operation, which are extremely serious for this type.

Yours sincerely,
A.H.F.

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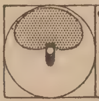
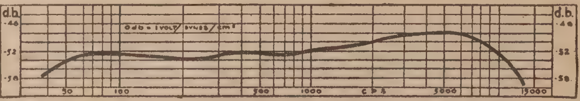


Pick-up Pattern



Approximate Frequency Response Curve

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a distinct peak in the overall sponse curve.

At the same time, the diminution NEGATIVE feedback allows the ective plate resistance to rise, so at the net effect on the ampli-r's characteristics is a "double-rrelled" one.

If a very large degree of feed-ck is used, then, obviously ough, its "accidental" removal in e supersonic region must lead to fects which are relatively more ticeable than would be the case ith less initial feedback. Peaks ould be more pronounced and nging effects of greater amplitude lative to the initiating signal.

RACTICAL EVIDENCE

As the editor has already demon-rated, these effects are quite no-eable in practice—at least on in-ruments—and lead to the inevit-le conclusion that it is dubious actice to concentrate a great nount of feedback into a single op.

Too much happens when the said op goes awry!

The worst effects of phase rotation in the major loop can be avoided if the effective plate resistance of the output valves can be maintained at a low figure.

Once again, this can be achieved tomatically by using triodes, and is, in fact, a potent argument their favor.

However, the same result can be hieved if a second feedback loop n be arranged around the out-ut valves, which can be relied on to remain as NEGATIVE feed-ack well beyond the frequency here the main loop becomes un-tisfactory.

In fact, the minor loop should main effective up into the region here the response of the ampli-er rolls off anyway, and there no danger of further peaks de-eloping.

But what has all this to do with ltra-Linear? Well, we're just about tell you.

To achieve the results we require, e minor loop need only apply from to 10db feedback, sufficient to ring the effective plate resistance own below the nominal value of e plate load.

ENEFICIAL EFFECT

Provided it remains negative, it an then be relied upon to "tame" e output stage at extreme fre-uencies, the major loop effecting urther substantial reductions in late resistance and distortion over e audible range.

Now there are three obvious meth-ds of arranging a tight minor loop round the output valves.

The first is to run the feedback rom each output plate back to its wn grid through an R/C blocking etwork. Alternatively, it may be inked into the driver plate circuit, s apparently envisaged by A.H.F.

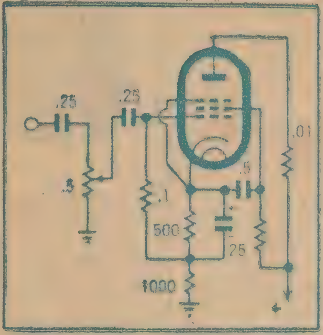
There are two objections to this cheme, as I have already stated. ne is the adverse loading on the river plate circuits and the other s the nuisance of having to pro-ide symmetrical driver circuits if he feedback is also going to be ex-ctly symmetrical.

Neither difficulty is insuperable, but they have to be overcome.

It is also noteworthy that the circuit is subject in its operation to series and shunt capacitance effects, as well as possible phase-shift due to the reactive plate load.

The second method is the one favoured by some English designers. This involves the provision of a split tertiary winding on the output transformer, which is wired in series with the output valve cathode returns.

It avoids the difficulty with input impedance and driver requirements, minimises capacitance effects, but stands or falls by the design of the output transformer. From what I gather, it normally stands, but the transformers are costly.



From a reader in Melbourne comes this suggestion for an input stage to suit the currently featured wider-range CRO.

The third method, of course, is the Ultra-Linear circuit, using feedback to the screen. It likewise avoids input impedance worries, it uses a standard Hi-Fi type of transformer with only minor modifications, but it involves a loss of power output in some cases.

In other words, each of the three possibles we have mentioned have certain advantages and disadvantages. They are all capable of doing the job.

If the Ultra-Linear is not well suited to certain classes of output valve, it is also true that cathode feedback is not suited to certain output transformers and grid feedback is not suited to certain popular phase inverters.

Whether you choose any of them —or none of them—depends entirely on circumstances. Let's examine the situation more closely.

TRIODE ENTHUSIASTS

Some enthusiasts inevitably start off with the pre-conceived idea of using triodes anyway and relying to a minimum degree on feedback of any kind. To objections about low plate efficiency and bulky power equipment they merely shrug the shoulder and indicate that another three or four pounds is of no consequence.

Their approach is a perfectly legitimate one and an amplifier like the "Playmaster 5" with its triodes and overall feedback is a good one by any standards.

Others may start off with a particular set of valves and equipment and the general idea of getting plenty of power and reasonable quality. The obvious answer is pentode connection, overall feedback and perhaps an extra feedback loop—if it can be managed!

But what of the very typical enthusiast who reckons that he wants some 10 or 12 watts of audio power, with the maximum attainable quality and the minimum attainable price?

Triodes are at a special disadvantage because of their low sensitivity and substantial power supply requirements.

That is why pentodes or tetrodes with overall feedback came to be the accepted thing for such a requirement.

UNDER SUSPICION

Now, however, such amplifiers are under suspicion for "peculiar effects" in the supersonic register, for reasons that I have already explained. Whether such effects matter with anything but super-grade pickups and speakers is as yet unproven, but you know what a dreadful thing suspicion is!

So attention on behalf of our typical enthusiast turns to a second feedback loop. Grid feedback is inconvenient, cathode feedback demands a more costly transformer, so . . . we come around to the Ultra-Linear circuit.

What if it doesn't happen to suit certain beam tetrodes? Well, then, we can easily settle for high-slope pentodes, with very gratifying results.

Plate efficiency is high, power output good, power supply requirements modest, output transformer no dearer than any comparable Hi-Fi tranny, no peaks or ringing in the supersonic region, low distortion, low output impedance and dead level response over the audio range.

All this, mind you, from a circuit with no more wires or components than the simplest conventional feedback amplifier.

Can it be said that such a circuit is "pointless"? I think A.H.F. might be hard put to it to prove his point.

Quite frankly, when I sat down at the typewriter, I had no special intention to champion the cause of the Ultra-Linear circuit.

However, having waded through the story from beginning to end, I find myself forced to the inevitable conclusion that it is just about the ideal circuit for the domestic audio enthusiast, who wants just what I said—maximum attainable quality at minimum attainable price.

ABOUT OSCILLOSCOPES

To change the subject rather abruptly, a reader from Melbourne has written to comment on last month's Oscilloscope article. He says:—

"In regard to your extended response CRO, I have one criticism. In the first 6AU6, wouldn't it be better to return the screen bypass to cathode? (See Langford-Smith, page 325.)

"How would an input circuit go, as per the sketch? Would it not reduce Miller effect to about 1 pf? The stage gain would still be about 8, as a guess."

Our correspondent's comment about the screen bypass is open to some query because he seems to

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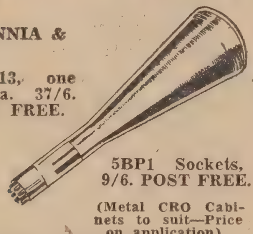

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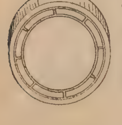

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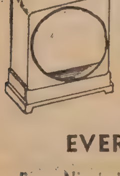

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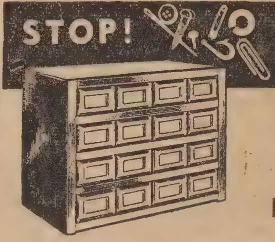

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have misread the reference and also failed to take into account the design of our deflection amplifier as a whole.

The point behind the reference in the "Radiotron Designer's Handbook" is that the screen should be bypassed to cathode, when it is desired to retain true pentode operation with an ACTIVE LOAD in the cathode circuit. It applies in particular to cathode follower operation of pentodes but it would have a secondary application to pentodes having unbypassed cathode resistors.

According to the reference, returning the screen bypass to cathode reduces input capacitance in these special circumstances and would, therefore, help minimise input control losses.

CATHODE BYPASS

As it happens, the cathode circuit of the first stage in our extended range CRO is bypassed to earth. To be sure, it uses a specially selected small value of capacitor, but it is operative over the range where Miller effect is most troublesome.

Therefore, because the cathode is bypassed, it is of little consequence whether the screen bypass returns to cathode or to earth.

The reason for the partial bypass is as we stated in the article, to provide compensation for the shunt losses occurring in the plate circuit and in the push-pull deflection stage which follows it.

If some such compensation was not provided, it would be necessary either to put up with the losses, or else to recast the whole amplifier system, with its associated power supply. This course we were not willing to follow.

Here, too, lies the answer to our correspondent's second observation regarding the input circuit. Even supposing that his suggested arrangement would reduce Miller effect somewhat, it lacks any compensation for losses elsewhere in the system and must necessarily have lower gain than our own circuit.

I would be most unwilling to sacrifice this compensation and gain for a 2:1 improvement in input resistance.

In actual fact, I am not at all certain that any increase in input resistance would be found possible. Even assuming that valve input capacitance can be reduced to vanishing point, the final result is still subject to capacitance effects in the potentiometer, the wiring and the valve socket.

It's one of those things that could only really be determined by measurement.

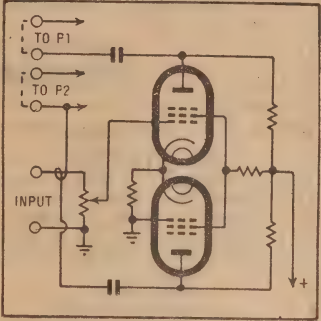
LARGER VALUES?

Just in passing, I would query the wisdom of a 25 mfd electrolytic across the cathode circuit. It is a "traditional" kind of value that is written into circuits these days, because it looks a lot of capacitance and doesn't cost any more, as components go, than smaller values.

For most purposes it is quite adequate but we must remember that its effectiveness as a bypass is governed by the frequency range we want to preserve without attenuation and the order of resistance across which it is connected.

These days, the tendency in audio equipment is toward wider range and the use of high Gm valves, with consequent low values of cathode resistor. From now on, you'll find a lot of cathode circuits bypassed with 100 mfd electrolytics of the type just now being released by local manufacturers.

In this case, if our correspondent wants to preserve the last vestige of bass response, it might be a good idea to bump the value up to 100 mfd or, better still, leave it out altogether, if the slight loss in gain can be tolerated.



A bright idea for cancelling out input capacitance. The lead from the second plate to its deflector is twisted around the signal input lead.

However, our correspondent goes on:

"My own approach was a little different. I have been using a pair of 6AC7's cathode coupled. I found that by applying a very small capacitive coupling between the plate of the second valve and the grid of the first, I got a level response that automatically compensated according to volume control position.

"In fact I twisted the lead from the second plate around the grid terminal of the first on its way to the Synch. control circuit."

Just in case you haven't been able to visualise the circuit, we had our draughtsman sketch it out, or at least the idea behind it.

First reaction is to say "Oh no! Positive feedback! Just too, too dangerous!"

But think again. At least some of the losses we are trying to combat are due to Miller effect and it is purely and simply negative feedback of a type we don't want.

What is more logical than to cancel the negative feedback we don't want with some positive feedback which can be arranged so very easily?

The right amount would have to be determined by trial and error but that would not be a serious chore for anyone dabbling with equipment on this plane.

No, I'll give full marks for the idea.

Any more forthcoming?

Comet Is Rediscovered

A very faint comet known as Wirtanen Comet, first spotted in 1948, has been rediscovered by Dr. Hamilton M. Jeffers and Miss Elizabeth Roemer of Lick observatory, Mt. Hamilton, California. The 18th magnitude comet is too faint to be seen except in the larger telescopes. It is in the constellation of Cancer the crab.

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OFF THE RECORD — NEWS & REVIEWS

Pablo Casals is generally considered to be the finest cellist of the century, unmatched either technically or musically. Most of us have never heard him in his youth, although he has made some outstanding records during the last 20 years. But I doubt whether even Casals could have outshone Janos Starker, the most recent master of the cello to make his mark.

By JOHN MOYLE

MOST record lovers have marked Starker from his first appearance in chamber music, and my own conversion began from his fine records by Nixa of the Beethoven cello sonatas.

Now we have an opportunity to examine his work under the most exacting acoustical microscope yet devised—a wide-range microphone placed a few feet from the finger board and a first class piece of recording ready to show up the slightest flaw.

I cannot withhold the five star award from it.

ROUND THE WORLD WITH JANOS STARKER — Music of Spain by Falla, Torroba, Granados, Albeniz and Cassado. Cello solos with Leon Pommers at the piano. Nixa PLP584.

Strangely enough, the Suite Populaire Espagnole, which is Falla's contribution, is the same as that sung by Victoria de los Angeles, a record reviewed herewith, although the songs are arranged in different order.

One might think it somewhat exhausting to listen to almost an unbroken hour of Spanish music played by a cello and piano. But when we meet such musical mastery as this, to say nothing of the tuneful material, and such incredibly fine recording, it is more of an experience than an ordeal.

A stringed instrument is somewhat unique in its demands on a performer. The piano, for instance, which is a percussive instrument, has most of its tone built in — the performer can do little more than control the speed of the hammers and the length of time he wishes to sustain his notes.

A cellist, on the other hand has vastly more under his control. He has a wide variation of tone and color available in his bowing, in his use of vibrato, and his control of pitch, so often the downfall of all but the best. He cannot hide his lack of technical mastery any more than he can hide deficiences in musical sensitivity and feeling.

I doubt whether any string player other than Heifitz has achieved mastery equal to that of Starker. This record is not only a delightful first volume of music—it is a demonstration and a music lesson rolled into one.

The realism of cello tone in this record is striking. The quality of every string and technical device, even the patter of fingers on the board, bring the instrument into the room, every note exactly in pitch even through dazzling finger work.

The piano, too, is extremely good, matching the cellist's change of mood from the caressing quality of a lullaby to the wild demands of the Ritual Fire Dance.

And if your equipment is wide range, you'll put this disc in the top class when you wish to show just how good it is. For me it is the record of the month.

LALO—Concerto for Cello and Orchestra played by Tibor de Machula and the Residency Orchestra (The Hague) conducted by Willem van Otterloo. Philips N00602R.

Strong Spanish rhythms and themes coupled with a hard working cellist are the main attractions of Lalo's concerto. The soloist has hardly a minute's rest until the la movement. The orchestra's co tribution in the first is virtual limited to a series of staccato chor and some almost inaudible accompar ment, and much the same pattern followed in the last. The cent movement is a most attractive A dantino in which the cellist h ample opportunity to show quality of tone.

Tibor de Machula is another e tremely competent performer, qu a number of whom have be brought into notice since the adve of the LP record. He is more th equal to the technical demands has to meet, and produces an ev and sure quality throughout.

I thought Philips balanced t whole thing very well. The cel hasn't as much vitality of sound we find in the Elgar reviewed els where but its voice is always clear heard.

If you like Lalo, you should al like this disc. Surface is good.

CHOPIN—Piano Concerto No. 1 in E minor Opus 11; Piano Concerto No. 2 in F minor, Opus 21. Played by Branka Musulin and the Stuttgardt Suddeutscher Rundfunks Symphony Orchestra. Conducted by Hans Muller-Kray. Nixa PLP574.

Two first-class performances Chopin's piano concertos which, think, will reconcile you to the even if in the past you have di missed them as not very successf attempts by the piano poet. It true that they haven't the sam impact as the classic form of t concerto, and the weight is so heav ly in the piano's favor that t orchestra is little more than a su port.

In this recording, the piano extremely forward, and, rightly s for it carries almost the entire bu den of the music. Every note important.

The pianist sees the part in stro lines, there is no languishing or fi dling here. The playing is big an full blooded, brilliant and sur footed. There is no lack of flex bility or lyricism, either, and y won't be disappointed at the wa the many lovely themes are handle

The orchestra, too, is good. The is enough reverberation to suppo the size of the whole performan without at any time clouding balan or outline.

The piano recording, for all i weight, is very clean right throu the range.

Unfortunately my copy showed u some surface noise near the end the F minor, but this may not, course, be true of every one. Othe wise the scratch level isn't bad. the two, I liked the E minor bes Both played best on EMI setting

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LISZT—Hungarian Rhapso- ies Nos. 2, 6, 12 and 15. Play- d by Louis Kentner, piano. Columbia 330SX1014.

'hese four are possibly the best)wn of the 20 Hungarian Rhap- ies—at least I am safe in say- that Nos. 2 and 12 would head list.

'he only serious comparison with s disc would be the opposite num- 's played by Edith Farnadi, who orded 15 of them in a splendid by Westminster.

Strangely enough it is the lady o plays them with the greatest undon—if anything I think she rs them into small pieces at times. For instance, she plays No. 12 about half the time it takes Kent- to get through it.

don't mean that he is stodgy— from it. He plays with all vitality and strength in the rld, but he replaces abandon with traint and a certain dignity, and kes quite a bit of the music at same time.

Technically, Farnadi's records are re forward and perhaps more pressive, but there is little to Kentner builds up a better tone, d makes his piano ring magnifi- ıtly. I like him immensely.

Surface noise is a little higher than ıal, but not really bad.

Mostly it is completely swamped the sound.

Plays best on EMI setting.

FALLA — Seven Canciones Populares Espanolas. GRANADOS. Colleccion de Tonadillas. VALVERDE — Clavelitos. Sung by Victoria de los Angeles, with Gerald Moore at the piano. HMV OBLP1037.

A gem of a record. All the songs Spanish in character, those of lla being based on folk songs, e or two of which you will prob- ly know. Of the others, Clavelitos Valverde is most likely to be niliar.

They are sung with great artistry a voice hardly surpassed at pre- nt when dealing with music of this nd. Its purity and power are ite outstanding, it has warmth d flexibility and a beautiful con- tency throughout its full range. n sure you must have admired is singer on some of her many cordings as much as I do.

Gerald Moore, as always, is the rfect accompanist. Probably all these songs would ideally have a itar accompaniment, and it is ite remarkable to see how his aying suggests this. His apprecia- on of the various rhythms, too, is rfect.

The recording is very good, par- ularly in the Falla songs, which e heard from a background of vir- ally complete silence. Only once the last song is there the slight- t hint of overload by the singer, d if you are quick you will hear w the engineer has dropped his vel a fraction to correct it.

Hear this one if you can.

J. S. BACH—Toccata and Fugue in C Major, Fuga in A Minor, Fantasia and Fugue in G Minor. Played by Albert Schwietzer on the Parish Church Organ of Gunsbach, Alsace. Philips AO1109L.

Bach and Schwietzer are so close- linked that anyone interested in gan music just can't afford not to without this record which is one three released at the same time. Schweitzer's approach to Bach is almost in the nature of a dedication and his ability to build the outline and inner life of these great works is as masterly as ever. Those who have been brought up on orchestral arrangements will find him something of a shock, but if they have any love for Bach they will soon begin to appreciate the difference.

The performance it must be admitted shows some signs of Schwietzer's age, and of the hands which aren't as supple as they were. The keen ear will catch a few tape joins, too, where no doubt sections have been gone over until they are right. Schweitzer has become still more deliberate, and even a little ponderous occasionally, but these are minor matters—this is organ playing unmatched by any living man.

Technically this record is good. The organ registration is clean and clear, and the steady tempo gives us a chance to hear what is going on. This is Schweitzer's favorite organ on which he has spent many hours in practice and recital.

One must recommend these records most highly. Rarely do we hear the spirit of a man so clearly spoken through the mind of another.

BIZET — Arlesienne Suites Nos. 1 and 2. Played by the Orchestra des Concerts Lamoureux conducted by Jean Fournet. Philips A00635R.

This is the incidental music to Daudet's play of the same name and most of it is as well known today as the play is not. Few associate its tuneful sound with tragedy among the French peasants of Provence.

The performance is quite a good one, and the disc is very easy to listen to. The orchestra shows plenty of life, as in the Farandole, and plays the famous Adagietto from Suite 1 most effectively.

The recording sounds like a studio job, and its balance might have been better in a larger room. The strings and brass are forward enough, but the woodwind at times sounds very lonely near the rear wall, and at no time do the cymbals get a chance to be really heard at all.

The bass in Suite 1 is a bit lumpy, and there is noticeable surface noise most unusual for Philips. The other side, however, is very much quieter, and sounds rather better all round.

I found it best with the EMI curve.

ELGAR—Cello Concerto played by Paul Tortelier and the BBC Symphony Orchestra conducted by Sir Malcolm Sargent. HMV OBLP1043.

The only other version of this concerto which comes readily to my mind is the Decca recording with Anthony Pini, but I doubt whether on the whole it is any better than this new HMV.

I would say that this cellist romanticises just a little more than some might prefer—he plays with the tempo a fraction and adds a few quick little slides or sloops which many cello teachers would dock him marks for doing.

But these are details, and can't mar a thoroughly fine performance which can quite safely be recommended.

The orchestra has a fully body, and so has the cellist and the mike placing is fairly close. This is something engineers must watch with the

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cello which is not a powerful instrument. A violin for instance is strong enough to sound quite convincing with some mike reinforcement in recording, but a larger-than-life cello, no matter how luscious it may sound, is out of character if this technique is overdone.

But no matter how powerfully we hear Tortelier, his consistant tone, clean bowing, and good intonation mark him as a fine performer.

Altogether this is a nice record, not particularly wide range, but good enough to sound well on all classes of equipment.

BACH — Brandenburg Concertos No. 2 in F major; No. 5 in D major. Played by the Philharmonia Orchestra conducted by Edwin Fischer. HMV OALP1084.

Very good, bright recording is the main feature of this record. The orchestra is in really fine form—the opening of the F major is a delight to hear, and I thought it was much the better of the two on all counts.

Reverberation is a little more than usual, but where solo wood wind is so important, I think it is essential to err on the generous side if the sound is to hold together. The orchestra thus maintains a cohesion and ensemble without which the music could well sound thin and empty.

Somewhat on the debit side is the rather obscured harpsichord in the F major, which is mostly overwhelmed by the forwardness of the other soloists, and the piano of Edwin Fischer in the D major which is just the reverse.

Nevertheless, I doubt whether there are two better recordings of these beautiful concertos available at the present time.

The surface is good except for the last few grooves of the F major where some crackles are heard when the music stops.

BEETHOVEN—Concerto No. 4 in G Major Opus 58, played by Mewton-Wood and the Utrecht Symphony Orchestra conducted by Walter Goehr. Nixa MLYP24.

It is hard to hear a record of Mewton-Wood's without a feeling of extreme sadness over his recent death in tragic circumstances.

He was without doubt a most gifted pianist and would have matured into a performer of great distinction. He had a true feeling for music, far removed from the modern sledge-hammer school.

This may not be the best G major in existence, but it has a charm of its own and at times is as good as one could wish. The general air is of the concert hall. Recording is remote so that both orchestra and piano get caught up in a haze of sound which, although it hides inner detail, is the kind of thing you will hear from your seat in row L.

The piano is a bit twangy, and seems to have a weak G, which your quick ears might be able to pick. The general tension is not high, but the pianist handles his cadenzas firmly and the record is particular easy to listen to.

The fact that it is complete on 10-inch disc is an advantage, but would be unfair to suggest it as t major one.

Surface noise is very low. T record plays cleanly on anything.

MOZART—Concerto in G Major, KV216; Concerto in D Major, KV218. Played by Arthur Grimiaux, violin, and the Vienna Symphoniker, conducted by Rudolf Moralt. Philips AOO199L.

There is always some differen of opinion as to whether or n these concertos should be played wi a small chamber group or give the full treatment with a moder symphony orchestra.

The only ready comparison have been able to make on recor is to play the G major as performed by Isaac Stern and a chamb orchestra for Columbia and release some little time ago.

My own impression is that bo these works are big enough to stan amplification in competent hands. don't think anyone will be i clined to quarrel greatly with an of the contributors to this ne Philips' disc.

I thought the Stern record, a though in the hands of a mor impeccable violinist, sounded little small, not to say anaemi against the broader and bigger background supplied by the Vienna Symphony Orchestra.

Arthur Grimiaux is well enoug known on the concert platform, bu not so well on discs. In both thes

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echnically it has a most satisfying ance, not over bassy, but well d in. Reverberation just right, a forward violin tone, which is te in keeping with its role in ting of the period.

f you are looking for a good pling of these two concertos, bably the best Mozart ever wrote, won't be disappointed.

he surface noise is very low. It ys well with the NAB setting.

MOZART—Concerto No. 23 in major; Concerto No. 24 in C inor. Played by Clifford Cur- on, piano, and the London Sym- hony Orchestra, conducted by osef Krips. Decca LXTA2867.

wo of Mozart's best concertos yed with the greatest competence both the orchestra and pianist. fortunately, I wouldn't say there much more to either of them— zon to me has never exhibited ch inspiration, and his playing e is meticulous almost to a fault.

may be wrong, but my impres- n is that these recordings date k to the 78 days. The dynamic ge isn't great, and there is a iddly" sound about them which sn't measure up to today's best. his applies particularly to the no, which, in addition, shows the familiar dirty quality on its der notes. There is evidence, , of some faulty micrograding and ove echo.

f you happen to be especially uck with this recording's particu- merits, then it's OK. But, I nk we'll have better examples of h works before we're through.

LISZT—Piano Concerto No. 1 in E flat major. WEBER—Con- ert Piece in F minor Opus 79. Played by Poldi Mildner and the RIAS Symphony Orchestra of Berlin conducted by Artur Rother. Radiola - Telefunken LE6513.

The Lizst concerto is played at a adier pace than by Enid Farnadi the Westminster recording issued ne time ago, but the general aracter of the recording is rounder d without a certain hard quality ich sometimes crept into the West- nster. It has less tension without any way being dull, and many ght like it better that way. Far- di is on the whole crisper and rhaps more reliable, but she is tainly a tear-away pianist when gets going. The pauses between "movements" in this latest re- rd are a little disconcerting.

The piano is on the whole more ward than Farnadi's. This is par- ularly noticeable in the second vement, where Farna'di slips nost down into the surface noise. The Weber Concert Piece is the e Schnabel played with such af- tion and charm. I can't say his rformance is equalled here, but it doesn't have to be for us to hear it with pleasure, despite some uncertain team work here and there. In fact I'd say that one of this disc's claims to your favor is the coupling of these two bright works.

There is quite a good frequency range in the recording although it isn't quite clean enough for AES and the surface has a few not-so-good moments during the Liszt. The Weber is OK.

CHAUSSON—Symphony in B flat major Opus 20. Played by L'Orchestra des Concerts Pasdeloup conducted by Jean Fournet. Philips N00701R.

This isn't a great symphony, but it is a very well assembled and melodius one. Chausson lived under the strong influence of Cesar Franck, and from the very first notes of the first movement we are aware of it. The long slow crescendo of the introduction might quite easily have broken out into the main theme of the D minor symphony of Franck.

Wagner, too, made his mark an Chausson, as indeed he did on almost every composer of the period.

I thought this orchestra made an excellent job of it. They play with sensitivity and good judgment, following smoothly the long poetic lines which flow through all movements, and displaying good weight and attack in the all important crescendos.

The recording isn't full range, but it is good standard quality. It is well balanced, with a good inner clarity and unobtrusive but proportioned bass and brass.

A good surface. It plays well with the EMI curve although it will stand AES and is somewhat brighter that way.

BEETHOVEN — Symphony No. 5 in C minor Opus 67. Played by the Concertgebouw Orchestra of Amsterdam conducted by Erich Kleiber. Decca LXTA2851.

I would pick this as the best Fifth yet released on records. It is quite without affection, and in my opinion plays in all the important ways just as a "Fifth" should.

Firstly Kleiber maintains a vigorous drive from which he will not be sidetracked. It gives the work a cohesion and vitality without which it is nothing, for there never was a symphony so essentially whole as this one. Break its continuity and you break its back.

This drive you will undoubtedly notice in the first movement when most conductors give themselves a few unauthorised rests. It may startle you, but it didn't take me long to see his point.

In some ways the second movement is the most successful, for failure to cope has ruined many good performances. Kleiber selects a perfect tempo and dynamic range which neither rushes nor drags. Note particularly the "rightness" of his acceleration near the end—he does it better than I've ever heard it.

His judgment in the scherzo is every bit as good, and his finale from its first full-blooded entry is an inspiring and majestic thing.

If space permitted it would be a pleasure to analyse this performance in full, just to demonstrate how good it is.

The only other record I would

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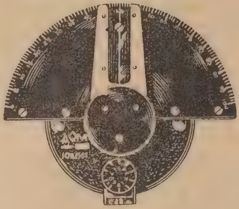

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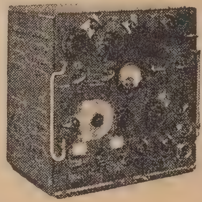

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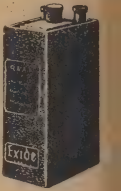

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Postage and Packing: 5/-. Interstate 6/-.

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Postage: 1/-.

nsider at present might be the uno Walter disc which isn't yet eased here. But I'd like to hear em both together to be sure.

The recording generally is good, , although it is a little edgy in e Decca position and shows a nt surface rustle as well. Wide nge equipments might like to drop e top a little.

SCHUMANN—Symphony No. in D minor, played by the Philharmonia Orchestra, conducted by Guido Cantelli. HMV OBLP1044.

After hearing this record I am nvinced that Cantelli is a genius, it is the first time I have ever ard the Schumann Fourth without ng alternately bored and charm- not at all convinced when it s done that the charm was worth ile.

t still sags a bit in the first l fourth movements, where neither ntent nor treatment are of a very h quality.

But Cantelli has conned the score h great skill. He has set his npo and balanced his dynamics that at no time does the music g, and mostly it sounds downht interesting. He succeeds in nvincing you that the symphony twice as good as it is, and that's ere we came in—it's the mark of a conductor.

Not that there isn't some beautimusic to be heard. The second vement represents possibly the hlight of the charm, which is st potent, but there is plenty of woven in between some very, y vertical writing.

really don't think you'll ever ar a better performance of this nphony, either in the playing or direction.

The sound is attractive and bright ypical Philharmonia. Surface se inaudible.

This all adds up to a pretty good ord, doesn't it?

SIBELIUS—Symphony No. 1 n E minor. Played by the Royal Philharmonic Orchestra conducted by Sir Thomas Beecham. Columbia 330CX1085.

The competition here is from an lier release of Anthony Collins, o, I am afraid, must take off honors. So also must Decca's ording, which is more cleanly lined, and has a balance which ows Beecham's effort to sound l by comparison.

Collins has a much more vigor- approach than Beecham, and a rule he gets away with it with ater success. Sibelius is a man contrasts, and he uses his brass particular to put an edge to his phasis. Collins makes sure of it Beecham seems afraid of its harsh gue.

As a result he rounds off his outes in this and in other ways ich give pale colors where strong es are called for.

The scherzo is probably the best mple of this. Collins, with his rp, fast tempo and precision ying shows much better judgent of what the music and the nphony requires of him.

There are moments when Beecham nes, of course. I did not think t either conductor was complete- successful in the lovely slow vement, where tenderness and ength must compromise in exmely fine balance, but Beecham s very well here.

There is much of Beecham's orchestra, which is heard below strength—I liked the Decca balance much better, although the tone is not entirely free from a touch of harshness on the Decca position.

If you are confirmed Beecham, probably you'll pick his disc. But, looking at the two objectively, I don't think I would.

THE CAECILIA MANDOLINE PLAYERS—Music by J. A. Hass, Mozart, Beethoven and Vivaldi, conducted by Wessel Dekker. Philips N00686R.

Full marks for a most unusual and charming record. It might come as a surprise to find so much beautiful music written by famous composers for these somewhat humble instruments, but this is just what you will find here. Mozart, of course, used a similar accompaniment in some of his operas, but I for one had not realised that Beethoven ever wrote for mandolines, although the music is not unfamiliar.

The Mozart numbers are sung by Paul Conrad.

Recording is really good, forward and with good frequency range. The completely silent background adds immeasurably to the enjoyment which I certainly received from this fine disc.

WAGNER—Excerpts from Die Meistersinger von Nurnberg (Hans Sachs). Sung by Otto Edelmann, bass, with the Vienna Symphony Orchestra conducted by Wilhelm Loibner, Philips N00680R.

Otto Edelmann is well known as one of the finest interpreters of the Hans Sachs role at the present time, and has appeared regularly in various parts of the world including the famous Wagnerian opera at Beyreuth.

He has a voice of exceptional resonance and dignity, and, although he made his debut in this role in 1951, he sings with an ease and authority usually associated only with years of experience.

This, obviously enough, is a specialised type of record, and may sound somewhat disjointed by its very nature, but there are many lovers of what is probably Wagner's finest opera, who will welcome it.

The recording is first-class, and the surface, as is so often the case with Philips, is well-nigh perfect.

HAYDN—Symphony No. 92 in G minor. Played by the Sydney Symphony Orchestra, conducted by Hans Schmidt-Isserstedt. Radiola-Telefunken LB5005.

I can't commend this record. It is taken from a broadcast, and the contrast with the records made by the orchestra in the University Hall of Sydney is too great. It is a faithful copy of what you would have heard over the air on a good receiver, but that isn't good enough to stack up against modern recordings, despite the bright performance.

Neither frequency nor dynamic range is good, and there are distracting noises off, including audience coughs and something that sounds like a tug whistle from the harbor, placing the concert probably in the Sydney Town Hall.

It isn't really a good advertisement for the orchestra.

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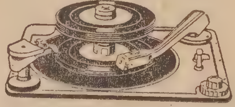

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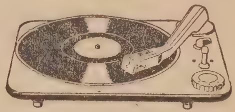

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RECORD NEWS FROM ABROAD

By DISCOBOLUS

ews this month includes a new LP groove standard promising better production and longer playing time. More binaural discs and tapes ive been received, which have proved even more successful than those ready heard. They seem to discount some of the criticisms raised editorally last month.

TH the present high degree of competition existing among d companies, a remarkable per of LP's are reaching the c which have a playing time dered impossible for commer- processing only a couple of years

x have established a lead with mber of discs of full orchestral c playing for just about an hour, heir latest addition to the series 12in containing three tone s by Richard Strauss—Don , Till Eulenspiegel, and Death Transfiguration—which is quite chievement.

is does, however, push a 12in -3 rpm disc about as far as it go, using standard microgroove ique.

is not surprising, therefore, to t that someone would eventu- decide that the technique would to be changed. And, although sitate to confuse the issue at early stage, I must break the that a new type of microgroove d will be on the market over- before this year is over.

u will be hearing a lot more the new "V-Groove" pressings, about new pick-ups to play .

TECHNIQUE

change is quite similar to the fer from 78 to LP, in that the radius will be reduced to ½ .0005in) and diamonds will be rsally used. And just as a 78 up head is not suitable for a new LP head will be needed ay the V-Grooves. Tracking ures must be reduced in pro- on to the decrease in the size of tylus tip, and the moving mass armature in a magnetic cart- , referred to the tip, must be han one milligram.

e net result of all this will be er surfaces, and less tracking tion, while the new ½ mil tip mean the ability to follow fre- cies almost four times those at upper limit of the standard 1 ps. On high grade reproducing ns, the biggest improvement be in transient response, but e public in general the biggest e in playing time.

ANTAGES

Groove discs will be cut as a r of course at something like rooves to the inch, and you can reduce that statement to mean- hat what is now on a 12in disc fit quite easily on to a 10in, a consequent reduction in cost, at a 6-sided opera will become ided opera.

case you are wondering just a "V-Groove" is let me say it does actually look like a "V", in that it has no flat m, as in the standard type LP. only company to use V- ve at present for all its existing LP's is Cook, and any Cook recording may be played back with a ½ mil stylus as well as the 1 mil, provided, of course, a pick-up is used which will accept the new tip size. Whether the idea will succeed commercially, I do not know. If it does, then we can look forward to better and better records. News of the new system is not just an idle rumor, as I understand that at least two pick-up manufacturers are at present developing new cartridges, and some record processors apart from Cook have signified their agreement to accept V-Groove masters.

BINAURAL

Further evidence of change has reached me during these last few weeks, with the arrival of some Livingston discs and tapes, all binaural, and all taking on a sound rather different from the Cook variety. The material ranges this time from a five-piece dance group to a 200 voice choir, with string orchestra and organ. The microphone placing for the large-scale recording consists of two mikes set up 100ft in front of the nearest performers. Having now heard a number of binaural records from both Livingston and Cook, including a good deal of serious music, I can only say that for me, at any rate, the result is completely satisfying, and it has been an eye-opener to watch other enthusiasts experience their first hearing of it.

Mr. Moyle last month mentioned critical speaker placing as a drawback. With Livingston this is not the case at all, and I consider that the particular Cook recording under criticism on this score has been deliberately made that way as a demonstration disc.

LOOK FOR MORE

Looking back over Mr. Moyle's comments, I cannot help but feel that most of them relate to single-channel discs as well—in fact more so. Who has yet found the right place in his room to place the speaker, and which engineer has arrived at the perfect mike position? As for frequency division between spread-out woofers and tweeters, the method seems rather a crude one with little relation to binaural or stereophonic sound. I personally look forward to more binaural records, whether they are discs or tapes.

The news was confirmed recently that AWA are to issue RCA Victor LP's under the RCA label before very long (the date is not yet fixed). We should then get music from many artists who have been absent from the HMV lists these last couple of years, and the American records will then be represented almost completely on the Australian market.

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SHORT-WAVE NOTES BY ART CUSHE

FLASHES FROM EVERYWHERE

HUNGARY is the latest country to commence "freedom" broadcasts. Recently we made mention of broadcasts from Peking as "Radio Free Japan" and the long lived "Free Spain" transmissions which have been in operation since the Spanish Civil War. Budapest uses the 9835 Kcs in this transmission from 4 pm to 4.45 pm, the first 30 minutes being in Arabic and the last 15 minutes in French. Every care is taken to make sure the identification of the station is not known.

After several days of listening, the frequency was found to be that of the Budapest station. The same frequency is used at 6.30 am in German and at 7 am in French. During both transmissions a gong (more like hitting a tin!) can be heard between the news items.

DOMINICAN REPUBLIC is the latest country to instal a 100 Kw transmitter for the well-known commercial station "La Voz de Domicana", located in Trujillo City, the Republic's capital. H12T uses the frequency of 9740 Kcs, and when only on 10 Kw was widely reported in this area.

CUBA'S COKG, formerly located in Santiago, has returned to the air, and now broadcasts from Havana. The frequency has also been changed from 8960 to 9750 Kc, a frequency which will not give the station clear signals from nearby transmitters but one which is inside the authorised 31 metre band. We find that COKG is best on Tuesdays when HCJB is silent on 9745 Kc, and the interference from Moscow on 9760 is the main deterrent to good reception.

St. George in Grenada is the home of the new Windward Island Broadcasting Service which was officially opened during the recent visit of HRH Princess Margaret. The station has been reported from the US where it has been reported operating on 3395 and 5980 Kc from 10 to 11 am.

LAST MINUTE TIPS

DJAKARTA is now operating on 6045 and 9710 for all three English transmissions at 9 pm 12.15 and 5.00 am. Vatican Radio is shortly to move to the outskirts of Rome where land has been leased for a new transmitting site. The present English broadcasts are 1.00 am on 7280, 9646 11685, 15120 Kcs; 4.15 am on 6190, 7280, 9646, 11685 Kcs also English to South Asia on Tuesdays 2.00 am on 9646, 11685 Kc.s and also on Thursdays at 2.30 am on 6190, 9646 and 11685 Kcs.

SINGAPORE'S British Far Eastern Broadcasting Service is now using two new frequencies. 15210 Kc at 11 pm and on 11700 Kc at 2.00 am.

CAIRO has dropped the 16 and 19 metre frequencies in favor of 12030 Kc for the session of English news broadcast to the Far East at 10.30 to 10.40 pm and closes soon afterwards.

EASTER ORGAN MELODIES

Station TGNA (Telling Good News Abroad) will broadcast a special program of Easter organ medolies on Sunday, April 10, from 2.30 to 3.00 pm over stations TGNB on 9668 Kc and TGNC on 11850 Kc. The program of organ numbers will be recorded on tape at the Spruce St. Methodist Church in Morganstown W. Va. by Ken Boord, well-known as Short Wave Editor of Radio and Television News. Reports on the reception of the broadcasts would be appreciated by the station who would also welcome an International Reply coupon to help defray postage expenses. Reports should be sent to Mr. Harold Van Brockhaven Apartado 60, Guatamala City, Guatamala, Central America.

U.N. ACTION ON RADIO JAMMIN

**The recent action of the United Nations General Assembly in addin
a clause to the International Broadcasting Convention requestin
countries to refrain from jamming broadcasts was carried by 37 vote
to nil there being 17 abstensions including the Soviet bloc.**

JAMMING was first noted by listeners in 1939 soon after the Munich crisis when broadcasts in the German language became interfered with.

World War II saw jamming stepped up by the Axis Powers and the BBC. The OWI (Office of War Information), forerunner to the Voice of America, found that their broadcasts to Europe were blotted out. The American operated ABSIE (American Broadcasting Station in Europe) used BBC transmitters, which were replied to by the Germans with the new "British Broadcasting Station". Its location was soon found to be in Northern France, and listeners found Lord Haw Haw and Tokio Rose a main source of enjoyment.

JAMMING CARRIES ON

The end of the war did not see the finish of jamming. Broadcast to Russia and later all Iron Curtain countries were interfered with.

To combat jamming all available transmitters are thrown against the barrage, some 70 in all.

As well as the BBC and VOA transmitters in the USA, powerful relays are in operation in many parts of the world as well as a floating transmitter ship "Courier" at Salonika.

America has relay stations at Munich, Tangiers, Salonika, Colombo, Manila, San Fernando, Okinawa and Honolulu. The jamming, a high pitched swirling noise, is transmitted by hundreds of small stations located behind the Iron Curtain, and the thoroughness of the devastating barrage is well known to all listeners.

The Western Powers and the jammers play cat-and-mouse, each one trying to out-do the other. The use of frequencies next to channels used by Radio Moscow in English, so called by the Americans as "Operation Cuddle", found Moscow in a difficult position, as jamming would spoil their English language broadcasts.

All times used are Eastern Australian. Notes from readers should be addressed to 212 Earn Street, Invercargill, N.Z.

RADIO AUSTRALIA

At the recent SEATO meeting at Bangkok RADIO AUSTRALIA was asked to commence special broadcasts to South-East Asia on the theme of education in Democracy.

An officer from Radio Australia is firstly to visit Thailand to find suitable frequencies for broadcasts from Melbourne. It is also intended to place receivers in village communities for mass listening, as the country has few radio receivers. The last known total was only 69,900.

We know all listeners will join with us in the wish that these broadcasts will do much to strengthen democracy in South-East Asia.

DUSK RECEPTION

During the past few months, the BBC have been experimenting, on 17705 Kcs.,
with a special transmitter directed
Singapore. It has a new stacked di
aerial, the first used by the BBC.
gether with GRA 17715 Kcs, both tra
mitters operated from Daventry,
GRA uses the conventional system.

Peculiar things seems to happen in
ionosphere, and although we are
definitely sure of it yet, it seems
some ionospheric disintegration ta
place around dusk, local time, res
ing in very poor reflection from th
layer. This effect does not seen to
criminate against particular waveba
as all frequencies in use suffer severe
nal strength attenuation.

Field strength at BFEBS at Singap
has shown a marked improvement
the new type of aerial. As both tra
mitters are operating from the same
the improvement can be attributed
the improved aerial system, which
overcome this problem of dusk recep
which faces short wave broadcasters.

RFE CAUSES TROUBLE

RFE (Radio Free Europe) has arou
indignation in some radio circles by
use of split frequencies. Recently a E
engineer pointed out to us an exam
of this difficulty concerning the use
GWG on 15110Kc.

GWG which has been used to So
Africa ran into serious trouble f
RFE on 15115Kc, but a strong pro
has recently been forwarded and t
may drop this frequency. Likew
Radio Liberation on 15105Kc has
been causing a bit of troble mainly f
the jamming associated with th
clandestine stations.

TIPS TO TUNE FOR

CAIRO broadcasting to Europe
9480 Kc to sign off at 7 am week d
and 8 am Sundays with popular
cordings. . . . TAP 9465 Kc carries
English news broadcast at 7 am f
Ankara . . . Latin Americans are ac
on 19 meters and the best signals
LRU Radio el Mundo, Buenos Aires
fair at 7 am, while CE1515 on 1515
Santiago, Chile, close at 2 pm and
Sao Paulo station PRB23 Radio Record
15139 hear at 12.30 pm. DZH9 in Ma
operating on 11850 Kc has a mission
broadcast in Japanese while the si
station DZ16 on 1780 Kc which also o
at 8.00 am has a news broadcast in E
lish.

TEST ON VOA

Kcs/ Calls.
3905 Manila-4 8.0 pm. — 3.0
(Testing to China)
6010 Okinawa-4 8.30 pm — 3.0
(Testing to East Asia)
11700 Philippines-4 8.30 — M
night (Testing to East Asia)

B.B.C., Changes:- GRJ (7325),K
from 7320 Kcs. GWF 9735 Kcs. 9560 K
and 15360 Kcs., no calls assigned. 39
Kcs., is a new frequency, used in
German service. GRC 3975 Kcs., is
other new outlet.

THE HAM BANDS WITH BILL MOORE

he finest example of amateur service in national emergency yet seen in Australia was pro- ded by NSW licensees during the recent catastrophic floods. Gradually the full story is eing pieced together, and in this article Bill Moore has tried to give a word picture of how amateurs did their magnificent bit in saving life and property.

T one year ago the emergency work radio amateurs on the North Coast SW was recorded as the finest nal service in peacetime rendered em in the public interest.

late February and early March of year, during the worst flooding in istory of NSW, they were to register ven greater achievement in emerg- working and amateurs throughout Commonwealth can be justly proud eir performance.

s a story that will possibly never be recorded unless those amateurs who ipated will, when time and cir- ances permit, pass to the WIA some s of their work.

ten listeners could obtain a com- picture of the activity with so channels in use—amateur to eur, amateur to police, to army, to F, to PMG &c.

en the operation was crossband ng recording of details even more lex.

y the careful sifting of individual ts will reveal the story. Details stations that listened to the work- vill also be important.

is extremely important that the d be complete. Details should be rded to the WIA, NSW Division, 1734, GPO, Sydney.

ORD RAIN

ord rainfall on the tablelands of (Dunedoo 10 inches on two con- ive days) caused rapid rises in the basins of many rivers in western including the Macquarie, Castle- Namoi and Gwydir and their aries.

Hunter River also rose rapidly ecord the worst flood ever. The ge in the devastated areas it is ated will run into tens of millions the death roll approximately 40 ns. NSW has never experienced ng of such magnitude and over a wide area.

was the radio amateurs in many who was to supply the vital com- cations' link to isolated areas. was to transmit and relay messages treme importance, and was afforded assistance and consideration by the rities.

oreciation of his work was expressed he daily Press, by broadcasting ns and various authorities.

ny of them were to see their homes ed and possessions lost. Others in flooded areas were more fortunate heir locations, and operated con- usly. Many returned to the air they had salvaged sufficient equip-

EPHONES FAIL

the peak of the crisis more than the State was out of telephone com- cation with Sydney and in many sectors were isolated. It was on the morning of Thursday, Feb- 24, when Noel Watkins, VK2APE, ubbo, notified Jim Corbin, VK2YC, dent of the NSW Division, that seri- looding was likely in the west.

ateur stations were immediately ed and from then on for nearly weeks nets were operating while lood waters passed along the vari- ivers.

ateurs located in the north west of and in the Hunter Valley com- d links in the most complex radio ork yet to be organised in peace- by the army, RAAF and police.

ateur operation could be divided nly into three main sections, nets e west and north of NSW linked with various other areas, a compact net in the Hunter Valley mainly handling traffic back to Newcastle, and further nets relaying messages to the North Coast of NSW.

In various other country areas stations were operating transmitting and relaying messages to the affected districts, they were often pieced together by various stations when the weaker signals made copying difficult.

Messages were handled for practically every State-wide and local authority in the area. They included the RAAF, army, police, various broadcasting stations, PMG, relief authorites, railways, Weather Bureau, Electricity Commission, fire brigade, Main Roads Board, local councils and other bodies.

The number of messages handled ran into many thousands including telegrams.

The nets ran day and night. In many cases during the first days of the crisis operators obtained only a few hours' sleep. It was not for about five days before many operators managed the regulation eight hours.

TWO BANDS USED

Operation by day was mainly conducted on the 7 Mc band and by night on 3.5 Mc/s. Long skip on 7 Mc was a problem at times but the 3.5 Mc band behaved splendidly.

Utter devastation of many portions of both Singleton and Maitland along the Hunter Valley put these two towns practically out of communication with other areas, and it was not until Harold Whyte, VK2AHA, of Newcastle, journeyed through rising flood waters to Maitland that this town had effective communication. He took with him his battery-operated portable equipment.

About the same time technicians at the Maitland exchange placed a transmitter on the 3.5 Mc band but they had no receiver.

VK2WI was requested to receive for them and was linked by phone. This transmitter was later used as an important link to a broadcasting station which transmitted flood warning and information to the local residents. Keith Rudkin, VK2DG, was at the transmitter site.

Harold operated for some 72 hours, covering traffic of extreme importance. He was later to have further links in the area with Bob Best, VK2TY, and Shorty Cameron, VK2NX. Later Geoff Partridge, VK2VU, and Alex Mathers, VK2JZ, of Singleton, appeared. They had rescued sufficient equipment from their flooded homes. Vic Holmes, VK2AKP, veteran of other flood operations, was also active.

NEWCASTLE END

The Newcastle end of the net was conducted by Frank Hinks, VK2AUH, radio inspector for that area, through official station VK2AA, and by Jim Cowan, VK2ZC.

This particular net was effectively operated and proved of inestimable value in passing messages for relief of the area.

Many other stations in the coalfields and Newcastle areas also provided valuable assistance.

In the western portion of the State amateurs supplied links to and from isolated areas. In Dubbo a number of amateurs were flooded out and Bob Smith, VK2AXS, and Noel Watkins, VK2APE, carried most of the traffic for the area. Dubbo was an important centre as it is headquarters for a number of utilities and for flood relief.

Tom Stroud, VK2AMR, was active later when floods abated, Max Moore, VK2II, and Bill Brooks, VK2ACT, also handled traffic at times.

In Tamworth Syd Smith, VK2APS, supplied an important link, as he has on past occasions, to the police headquarters for the area. He worked into many nets. Don Dawson, VK2YU, Merv Finlay, VK2ATD, and N. Taylor, VK2ASQ, were active, too, sometimes for long periods.

Tamworth with its airfield proved an important centre as the emergency progressed. Communications from the area as provided by amateur radio was extremely effective.

Rod Pike, VK2ACU, of Coonamble, was that town's sole means of communication. He operated for over 100 hours, passing PMG telegrams and emergency traffic of all kinds running into hundreds of messages.

Jack Hill, VK2ADT, and Ted Lumbewe, VK2ZX, handled communication for Inverell in its first serious flooding.

Considerable traffic was routed through this area and Jack was directed by the police to leave the high school pupils alone for a week which he spent continuously on the amateur bands.

N.W. LINK

Ray Carter, of Quirindi, VK2HC, provided a valuable centre in another flooded area. He was to establish the focal point of what was to be termed the North-West Link. As a local shire councillor he ran from his home QTH the local bush fire emergency net on 2600 Kcs.

Two stations of the net were used extensively during the flooding working back to VL2AQ the net control station. Ray was linked on the amaetur band with Tamworth via VK2APS, VK2YU and VK2ATD, and the Sydney end of the net was provided by Harry Powell, VK2AYP. VK2JC, Harribri, and VK2ADT, Inverell, passed much traffic into the net. Harry VK2AYP in Sydney effectively covered and cleared the important messages directed to him.

Most amateurs agree that he procedure, speed of traffic handling and operation of this net was far in advance of any other operating.

The story of Hart Wall, VK2JC, of Narribri, in the floods is one of the most graphic. Hart was in Sydney when the floods commenced. He chartered a plane and flew home and immediately operated with VK2JC. Soon the flood waters ravaged the town, divided it into three sectors and caused tremendous damage.

As soon as the major flooding ceased, Hart and Chick McCartney, VK2DK, transported their equipment o the aerodrome where it was found to be unserviceable due to damage from the water. They immediately arranged with the RAAF to fly in a AT5 which arrived at 3 pm Monday. At 7 pm they were on the air from Hart's QTH with still a foot of water over the shack floor. The journey from the aerodrome had been made with the aid of a prader with the gear perched on top.

From this period onward these two amateurs provided yet another single link from an isolated area.

GUNNEDAH CONTROL

On the Sunday morning Gunnedah Flood Control appeared on the 3.5 Mc band, built practically overnight by local radio men. This station working back to VK2WI established another link in the chain of stations in the west. Norm the main operator using a tape recorder worked endlessly for 10 days and finished converted to amateur radio.

Ben Ash, VK2ABT, provided the only link from Coonabarabran. Operating ex-

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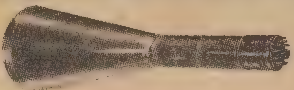

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Y Plates 0.33, 0.45
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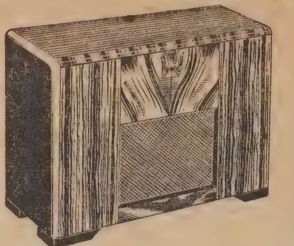

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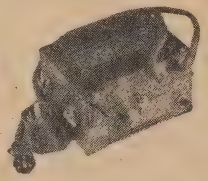

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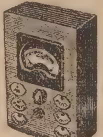

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ely, he covered and cleared con-
ible PMG traffic.
l Watkins, VK2APE, left Dubbo as
floods moved westward journeyed
arren with his portable equipment,
ishing a station to cover that par-
r area.
er Joe Ackerman, VK2ALG, moved
algett with army equipment and
ed back to VK2WI.
ly in the emergency Mac Cormack,
RK, PM at Bourke passed many
ams back to VK2AA. Leith
A, operating from the ducks also
amateur frequencies. He had
lled over from Grafton with the
les.
various stages G. Clipsham, VK2SJ,
Parkes, was prepared to move
Condobolin, and Norm Skulander,
W, of Orange, in to Nyngan.
Newcastle and Sydney ends of the
nets were handled by both official
amateur stations. Newcastle was
ed by official station VK2AA for
PMG. They were linked to RAAF
mstown and all official relief
s. The police station VKG3 was
operating, with VK2ZC, VK2FS,
T also active.

RK OF VK2WI

official WIA station VK2WI was
ted continuously on the 3.5 Mc
s for nearly two weeks and re-
d the bulk of amateur traffic
ted to Sydney.
was operated for most of the
d on 7 Mc from Jim Corbin,
C's QTH at Eastlakes and 3.5 Mc
VK2AD's QTH at Beverly Hills.
er it was operated from VK2FH,
A and VK2EL home locations.

e shift up to four operators assisted
imes to keep the traffic records
ght and telephone inquiries and re-
checked. This was the second
sion when VK2WI was used ex-
vely for emergency working and
official link was to prove invalu-
between the various stations.
also provided a link between the
eurs and official bodies requiring
tance.
aham Hall, VK AGH, Harry Calde-
VK2DA, Stan Bourke, VK2EL, Harry
ll, VK2AYP, and others handled
traffic.
ks to the north were very im-
ant as telegraphic communication
of Newcastle was cut. Much of
traffic was taken by VK4AB and
PQ and other VK4 stations, and
nsmitted back via landline. North
t and Tablelands stations operating
ded VK2PA, VK2AHH, VK2AEY,
SR, VK2ADE, &c.
Western NSW many stations out-
the flooded areas operated from their
llent locations, and heard signals not
ble in Sydney.
ose that operated extensively in-
ed zone officer Hugo Stitt, VK2WH,
XZ, VK2AMV, VK2JV, VK2SJ,
WH, VK2JW, VK2ALX, VK2BW
BT, VK2PN, VK2AJO.

nd conditions were quite good es-
ally on 80 metres and static levels
too high. It was possible to work
band practically all day over 200
o miles. Some of the lower power
ons set up for the emergency had
culty at times to cover any dis-
e, but with the aid of relay stations
was possible to cover most of the
ted districts.

At times most of the low frequency end of the band 3500 to 3600 Kcs was full of emergency nets. Up to seven were operating at a time, and five nets operated in this sector for many days.

Long skip was a problem at times on the 7 Mc band but considerable traffic was handled by day with up to four nets in operation.

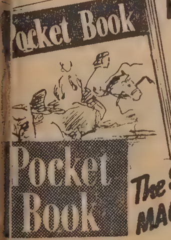
VK2AA, Sydney, used 3501 and 7002 Kcs, VK2WI 3525 and 7050 Kcs.

At one period VK2DX, at Macksville, on the North Coast of NSW who uses the 14 Mc band exclusively had an emergency message to handle. Due to skip he could not contact NSW stations so the message was passed to ZS5DE, South Africa, who in turn relayed the message back to VK2.

In New Zealand the RAEC, the NZ emergency amateur radio organisation, performed valuable work by keeping channels clear for emergency working. The organisation performed a similar service during the North Coast floods of last year. ZL2IY, ZL3OP, ZL2ACV, ZL2AJB, were among the stations heard rendering assistance.

Other stations active and not previously mentioned included VK2ANE, army station, Middle Head, VK2MF and VK2AQI, Armidale, VK2AWY, VK3FH, VL2JA, VL2JF. If any calls have been omitted, which will almost certainly be the case, it is regretted that one man cannot yet account for them all.

Amateurs in Australia must be elated by this contribution to national welfare made by their fellow hobbyists in NSW



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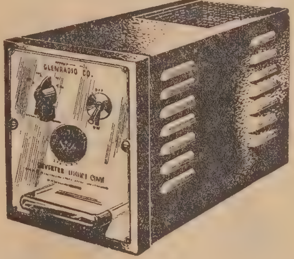

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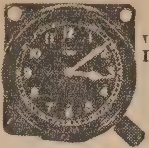

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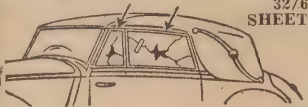

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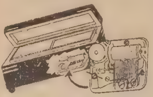

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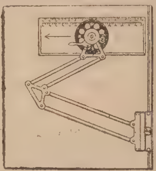

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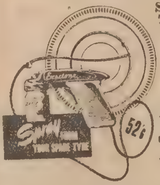

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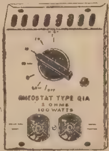

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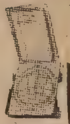

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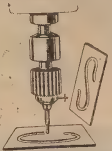

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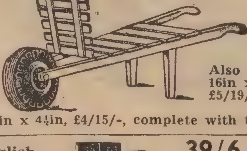

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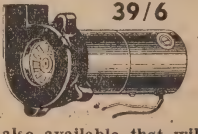

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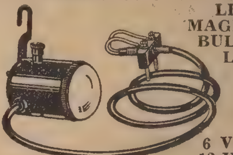

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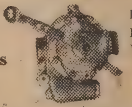

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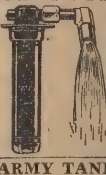

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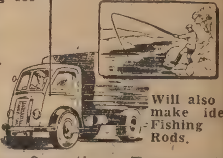

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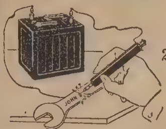

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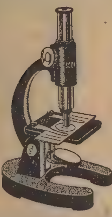

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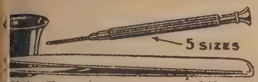

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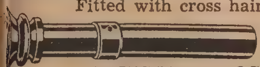

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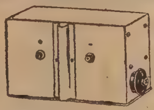

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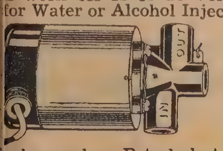

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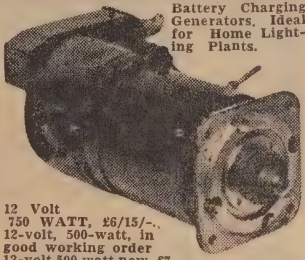

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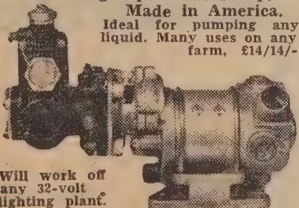

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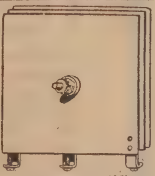

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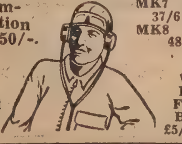

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8/9

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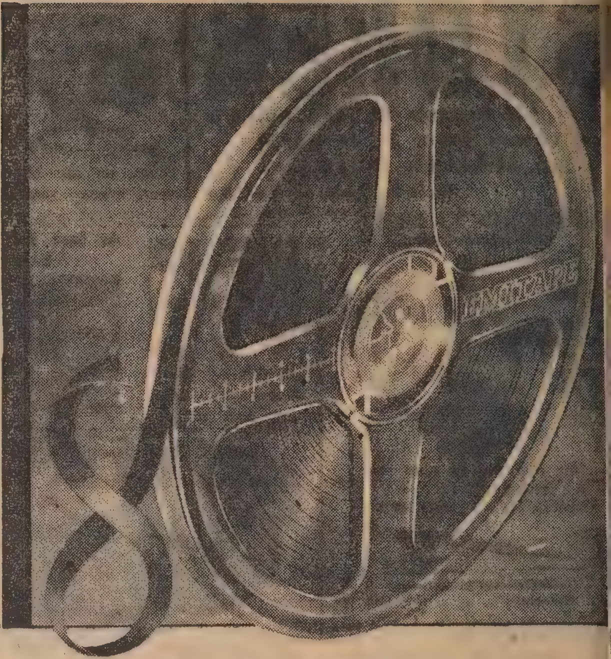
IN BRITAIN

ANNOUNCE



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CONTACTS FOR ELECTRO-FLASH

'n order to use an electronic flash unit a camera must be fitted with contacts. In this ırticle we discuss some aspects of commercial contacts and also the possibility of fitting simple contacts to an existing camera.

RST the commercial contacts. Even the simplest box cameras fitted with contacts these days, le professional types may use istable versions with up to three erent settings. The question urally arises as to where the tronic flash stands with regard these varieties.

ne of the advantages of the elec- nic flash is that the flash is l with virtually no delay when triggering circuit is closed. This kes things easy for the shutter nufacturer, who needs to provide acts which simply close at the nent the shutter blades reach the y open position.

his is such an easy requirement satisfy that the simplest types ariably follow such a pattern, n though they were originally nded for use with expendable bulbs.

IITATIONS

n this respect the expendable is only suitable for use with n if one assumes certain limita- ns. Thus, unless a synchroniser used, either separately or as t of the shutter mechanism, it is possible to use a shutter speed her than about 1-25 second, this caution being necessary to allow e for the bulb to reach full bril- ce.

o accommodate the various types flash bulbs, as well as electronic h systems, it is the practice to ip modern shutters with con- s which can be set to suit the ering requirement of each. Thus have the "X" setting, the "M" ing, and the "F" setting, with "X" and the "M" being the most popular.

n the "X" setting the contacts e at the moment the shutter des reach the full open position, "F" setting introduces a delay three to five milliseconds, and the " a delay of 16 to 17 milli- onds.

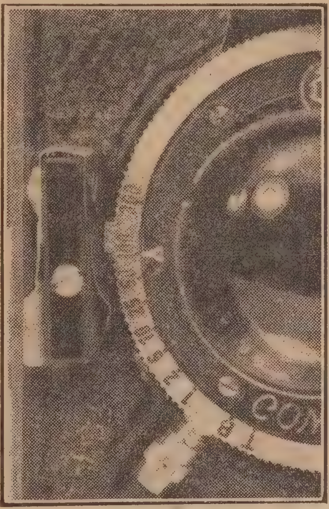
For electronic flash work it is airly obvious that the contacts hould be set to the "X" posi- ion.

CAL PLANE SHUTTERS

n the case of cameras having al plane shutters there is an ad- onal complication. Not only st we make provision for cor- t synchronising, but we must consider the width of the slit the blind.

This is a matter which appears cause many amateur photograph- a lot of mental stress, there ng the impression that this is difficult matter to understand. fact there is no great difference ween the problem of focal plane tters with electronic flash and the problem of the same shutters with flash bulbs.

The cause of the difficulty is the fact that the focal plane shutter does not expose all parts of the focal plane at the same instant, the high speed of the shutter being obtained by exposing through a slit which passes across the front of the film. By making the slit very narrow it is possible to achieve an effectively high shutter speed, even though the movement of the slit across the film is relatively slow.


A close-up of the home-made contact described in the article. Note the loading lever which completes the circuit when the shutter fires

Where any kind of flash is involved it is fairly obvious that the light will have to illuminate the subject for at least as long as it takes the shutter slit to make this movement, otherwise the negative will be exposed over only a portion of its area.

In the case of flash bulbs the problem has been solved by the development of special long burning type bulbs which give an essentially constant light for the rerequired period.

By its very nature the electronic flash is unable to do this, the longest burning types so far developed being about 1-750 second, which is quite useless as far as the focal plane shutter is concerned.

This does not mean that the focal plane shutter cannot be used with electronic flash, but it does mean that it can only be used with those speeds which open the slit to the full width of the negative. In most cases this condition applies for speeds of 1-25 second or longer, but examination of the camera when it is unloaded will soon reveal the exact details.

SECONDARY IMAGES

Indoors the only limitation this imposes is the need to avoid a "ghost" or secondary image due to the normal lighting and which may affect a fast film over a period of 1-25 second if a large stop opening is used. This condition is best avoided by reducing the main lighting where possible and/or using a flash unit with the highest possible light output in order to make possible a small stop opening. The

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high output of the Radio and Hobbies' unit would be valuable in cases like this.

Out of doors it is frequently desired to use the flash unit, even in sunlight, in order to brighten the shadow areas of the subject. In black and white work this can minimise the limited tone range normally possible on printing papers, and in color work it helps to avoid incorrect color in the shadow areas where a wide range of light values is involved and which cannot be handled by normal color films.

SERIOUS DISADVANTAGE

Here the focal plane shutter-electronic flash combination is at a definite disadvantage, since it is frequently necessary to use a higher shutter speed than 1/25 in order to give correct exposure, for sunlight, at the stop opening dictated by the electronic flash. Once again the higher the light output from the flash unit the better, but the problem can be a difficult one.

For this reason the person considering the purchase of a new camera may be well advised to think twice before investing in a focal plane shutter type, attractive though these may be in other respects.

It is also interesting to note that many of latest type cameras are being fitted with behind-the-lens shutters rather than between-the-lens types, thus making possible the interchange of lenses even though the camera be loaded; making them equivalent in this respect to the focal plane type.

And now comes the question of what to do about old style cameras, mostly made before the war, and which have no contacts fitted to the shutter. In most cases these are perfectly good cameras in every other respect and the owner has no desire to trade them in on a new model (and drop a substantial amount of money in the process) simply to acquire a shutter with contacts.

A good camera mechanic can fit contacts to most of the well-known shutters and many users prefer to adopt this solution to the problem. However, a fair amount of fine work is involved and the job is fairly expensive so that there may be little to choose between the cost of fitting contacts and trading the camera in on a new model.

It must also be pointed out that many amateurs have attempted to fit contacts to shutters, with very inferior results at a high price. At the best the contacts fail afer a short while; at the worst the shutter may be seriously damaged.

An alternative scheme is to fit a simple contact arrangement to the camera externally, using the loading lever of the shutter either to actuate the contacts or, more usually, as an actual contact itself.

CHECKING THE SHUTTER

This arrangement is quite feasible because the loading lever normally moves with a constant relationship to the position of the shutter blades when the shutter is fired. Furthermore, this position is easily determined by allowing the shutter to discharge slowly (holding it as the release is pressed) and noting its setting as the blades approach the fully open position.

With this data available it usually possible to find a spot on front of the camera where a sim insulated contact may be moun it being so placed that the circuit be completed through the frame the camera at the appropriate mo ent when the shutter is fired.

The accompanying photogr shows a typical installation on writer's own camera, an old war made way back in BC (before c tacts). The contact is made fron scrap of shim brass about .00 thick and which was sufficien springy for the job, even though was never intended for work of kind.

The contact is mounted on a sn block of black bakelite salva from the radio junk box. A piece perspex could also be used, but d not usually make such a neat finis

The block of bakelite is mour on the camera by means of countersunk 10BA screw. Fort ately there was a mounting hole the front of the camera at a suita point, being used to fasten the m front to the main framework.

SIMPLE GLUE

To locate this it was necessary remove the fabric covering the fr of the camera, a process wh may seem a little drastic. Actu this is not so and it is quite normal thing when cameras have be serviced. The secret is really the adhesive used to fasten the fab which should hold firmly with normal wear, yet be capable of ing freed without risk of damag the fabric.

One of the best mixtures for is a quantity of shellac dissolved methylated spirit, the proportion ing adjusted to give a moderat sticky glue.

Assuming that a glue of this t has been previously used it will relatively easy to lift the fabric inserting the blade of knife un one corner and easing it carefu away from the metal.

In the writer's case the origi screw, a small countersunk 10 was removed and another one similar thread, but much long obtained to go in its place.

The best shape and size for bakelite block was then decided a after it was made up, the contact cut from shim brass and shaped engage the loading lever at the c rect point. The whole assembly thoroughly tested before the fab was replaced, a small hole be punched in the latter to allow screw to pass through to the t ping in the frame.

CONNECTIONS TO GUN

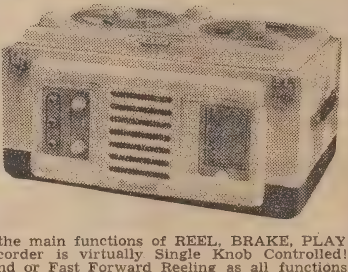
The contact is held onto the bl by means of another 10BA screw a nut. As can be seen from the pho graph the shim brass folds over top of the block and is thus ancho on both sides. Also held under mounting nut is a contact from miniature four pin speaker soc and the whole combination, sh brass, contact, and nut are solde together. However the screw free to be removed if so desired, th enabling any repairs or modificati to be made without difficulty.

A pin salvaged from an old va base will fit the contact and this connected to a lead from the fl gun, the return circuit being throu the frame of the camera. If it sho

(Continued on Page 119)

Ferry

"DELUXE"
RADIO-TAPE UNITS



● The FERRY is the only radio-tape recorder marketed in Australia in which the radio tuner is actually part of the equipment proper. It is not an attachment! But is an integral section of the unit, matched for the best performance, reception, and blending into the streamlined design.

FREQUENCY RESPONSE AND SPEEDS:
50 to 12,000c/s — 7½ IPS.
50 to 9,000c/s — 3¾ IPS.

UNISELECT CONTROL: Selects the main functions of REEL, BRAKE, PLAY and RECORD. Thus the FERRY Recorder is virtually Single Knob Controlled! It is impossible to erase during Rewind or Fast Forward Reeling as all functions are interlocked by this control.

PRESELECTOR CONTROL: Enables the direction of REELING to be decided upon at any setting of any other control . . . may be used as a "shuttle" of the tape. The MONITORING (during recording) feature is also selected by this control, being effective on either in-built speaker, 'phones, or external speaker.

SPEED CONTROL: Instantly selects the required speed, and the correct recording equalisation for the speed selected! An intermediate position of this control gives access to the P.A. facility, and disconnects the Mains Supply from the Three Motor Tape Transport System.

TAPE TRANSPORT SYSTEM: Three motors are employed and their applied voltages are changed to suit the function selected by the UNISELECT CONTROL; with DC being applied for instant, safe BRAKING, and applying a "drag" to the supply spool, which with the correct application of pressure devices, ensures performance of professional stability.

TRACKING SENSE: Standard Half-track, using ELMEC Precision Tape Heads.

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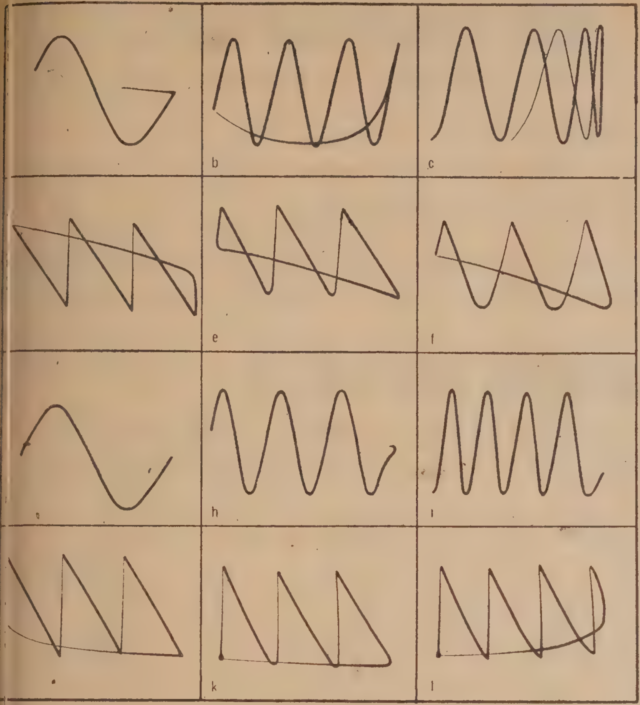
VIC.: TOPLINE RECORDING SERVICE,
5 Buckley Street, Noble Park—UM9402
W.A.: SUBURBAN RADIO CO.,
334 Charles Street, Nth. Perth—BA2395

IMPROVING THE CRO TIME BASE

(Continued from Page 39)



gure 6: Diagrams a, b, and c represent waves at 50, 5000 and 50,000 cps observed th the sawtooth wave originally available, and shown underneath. Diagrams g, and i are the same signals displayed against the sawtooth wave from the same oscillator but through wider-band amplifiers.

led by any sign of a return trace. difference between this latter ern (i) and (c) is so obvious ot to require comment.

figure 7, we show a further uit of a 5-inch CRO, amended nclude the new time-base ampli- It contains two more valves a few more parts than the orig- but its performance is vastly er.

eaders who have built similar ruments with ex-disposals 6SH7 6AC7 valves could well adapt to use the same circuit ideas.

ysically, no great changes are uired to instal the new stage he original Standard 5-inch Os- scope. The twin triode must, ourse, be removed and miniature ets on adaptor plates installed e two available socket positions. wiring is simply added, as per circuit, keeping the components but not too crowded.

e input signal should be con- d from the front panel to the grid by a direct, unshielded

om the 6AU6 plates, the signals forward to the panel through s capacitors, hung firmly on tag s. Another set of capacitors is ected in series with the deflec- plate input terminals, the sig- being carried toward the rear he chassis, underneath, by stiff hetti-covered busbars.

e busbars should be run side side, but not taped together. should be kept clear of the sis to avoid loss from stray shunt capacitance, but they should also be kept well away from any vertical deflection components.

We have already suggested, in the last issue, that the leads to the vertical deflection plates be run side by side above the chassis.

Stray coupling between horizontal and vertical deflection circuits is almost invariably to blame for wave patterns acquiring a lean to one side, or being unduly peaky on one side, or even developing loops at certain frequencies.

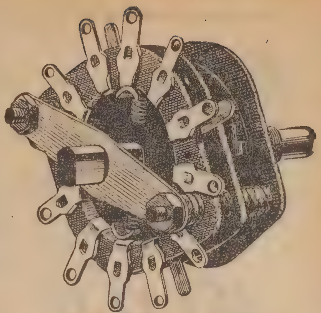
As we stated previously, the balance between the push-pull deflection amplifiers is not particularly critical, since the differences tend to average out in their effect on the electron beam.

The values quoted for plate load will be close enough for ordinary requirements, but can be amended for more exact balance.

When adjusting the stage it is wise to allow the valve whose grid is earthed to deliver a trifle larger signal. At high frequencies—above about 20Kc—the balance will tend to change over due, probably, to the cathode tending to bypass itself to ground via the heater-cathode capacitance.

Having completed the wiring to the horizontal amplifiers, the trimmer can be installed across the 1.0 meg. feed resistor and the job is done.

If you're in the habit of looking at high frequency or supersonic waveforms, we think you'll appreciate the difference.



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10 AMP.
(World Patents pending)
GENERAL: It is the only Single or Multi-Pole Rotary Selector Switch which combines 10 Amp. current capacity with small physical dimensions. It is interchangeable and can be used in conjunction with an "Oak" type assembly.
Mechanical Operation Test.
The Palec Switch has withstood 50,000 revolutions at 60 R.P.M. without mechanical failure.
RATING—10 Amp., 250 V.A.C.
CONTACTS—
Silver Plated—non-shorting only.
Resistance—800 Micro-Ohms.
TEMP. RISE ON CONTACTS—
(with 10 Amp. Conductors)
at 10 Amperes 10° C. rise
at 20 „ 30° C. rise
at 30 „ 50° C. rise
DECKS—1 to 8 max.
POLES PER DECK—
1 Pole—max. 12 contacts
2 Pole—max. 6 „
3 Pole—max. 4 „
4 Pole—max. 3 „
OVERALL DIAM., 2-1/16 in.
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We will design and build Switches to requirements.
Available—leading Wholesalers.
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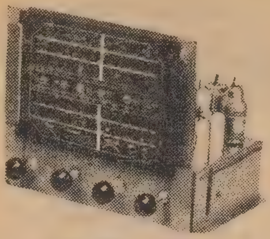
A SUPERB CRYSTAL MICROPHONE INSERT
THE "ACOS" MIC 19-4
- Frequency response flat from 40 to 6000 c.p.s.
- High output level — 50db.

Price **£1'19'6**

Available from leading radio houses everywhere.



NEW RADIOGRAM-CHASSIS

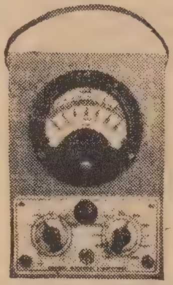
(DUAL-WAVE) FULLY GUARANTEED

These chassis give excellent local, interstate and overseas reception, and are fitted with pick-up terminals and radiogram switch. On-off switch is fitted to enable power to be switched off from set.

Supplied tested and complete in every detail with five standard valves, 6J8G, 6SK7G, 6SQ7G, 6V6G, 6X5G and 12in Rola or Magnavox speaker.

£17/17/6
PACKING and FREIGHT EXTRA

NEW UNIVERSAL-MULTIMETER



Manufactured by Robinson Electronic Laboratories

Incorporating 4½in World Famous American Weston Meter

This high-grade instrument is fitted in a durable and attractive Hammertone-finished case with self-contained batteries and supplied complete with test prods.

D. C. Ranges	A. C. Ranges	D. C. Current Ranges	Resistance Ranges	Output Ranges
0-12V	0-12V	0-1.5MA	0-5,000 ohms	0-12V
0-60V	0-60V	0-12MA	0-50,000 ohms	0-60V
0-300V	0-300V	0-60MA	0-500,000 ohms	0-300V
0-1,200V	0-1,200V	0-300MA		

PRICE
£12/17/6
Plus 12/6
PACKING & POSTAGE

ALSO DECIBEL SCALE-18 to plus 5D.B.

Visit Our Spacious Store at

640 KING STREET, ST. PETERS

(200 yards from St. Peters Station)

WHERE THERE ARE HUNDREDS OF LINES TO BE CLEARED IRRESPECTIVE OF COST

All goods advertised available at either Leichhardt or St. Peters

For after-trading hours or weekend Enquiries Phone WF8948

Please address all correspondence to 479 Parramatta Rd., Leichhardt, N.S.W.

METROPOLITAN RADIO SUPPLIES

640 KING STREET, ST. PETERS,
N.S.W.
PHONE LA6087

479 PARRAMATTA ROAD,
LEICHHARDT, N.S.W.
PHONE LM3610

NEW ELECTRIC CLOCKS

These new English alarm clocks are self starting and are in an attractive brocaded case. Supplied complete with power lead.

HALF NORMAL PRICE

25/-

TRANSFORMER SPECIALS

dget power transformers upright mounting imary 240v. Secondary 6.3 at 3amp and 0x260 at 50ma. **22/6** Plus postage.

0ma potted transformer primary 240v condary 400x400 at 100 ma. And 5v at 2amp.

28/6

By Rail or Airfreight. Too heavy for post.

NEW VIBRATORS

W.A. standard six pin synchronous vibrators original cartons 12 volts. **20/-** Plus postage.

W.A. heavy duty synchronous gas filled rators six volt. **10/-** Plus postage.

NEW 12v. VIBRATOR KITS

These new vibrator kits contain standard A.W.A. six pin synchronous vibrator, upright mounting potted vibrator transformers, two 8MFD electrolytic condensers, H.T. and L.T. chokes and vibrator socket

Output 200v at 50ma **45/-** **Plus postage**

Ideal for car sets, small amplifiers etc.

ACOS CRYSTAL PICK-UP CARTRIDGES

These Acos units are suitable for replacement on most 78 pickups. Supplied with set screw.

10/-

ROTHERMEL SAPPHIRE NEEDLES

These sapphire needles which are retailing at 12/6 play 2000 recordings.

3/9

CONDENSER SPECIAL

Boxes of 100 new mica and paper condensers in values ranging from 50pf mica to .5 400v papers. Each box includes .0001, .00025, .00075, .001, .008, .02, .05, .1, .5, etc.

Price 30/- per 100 PLUS POSTAGE.

CARBON RESISTORS

ll known make of carbon istors in values of 100 ohms 5 megohms. In 1-watt, ½-tt and 1/3 watt. All resiss are standard color coded in original cartons. In of 100 mixed values comsing 50 1-watt, 25 ½-watt, 1/3-watt.

ce .. ..
1/6. **12/6**

N LOTS OF 500, 50/-.

SOLDER

English multi-core solder in 1lb reels.

12/6 per lb.

Postage extra.

NEW-SWITCH POTS

Standard - switch potentiometers — ½-meg or 1-meg.

6/6

Plus postage.

NEW DYNAMIC SPEAKERS

7in Dynamic speakers by leading manufacturer, 1,500 ohm Field coil, 7,000 ohm Transformer
or
Ovaltone Dynamic Speaker 9in x 6in 1,000 ohm. Field, 5,000 or 7,000 ohm Transformer

20/- EACH

(POSTAGE—NSW 3/9, Interstate 5/9.)

NEW I.R.C. RESISTORS

I.R.C. carbon resistors, ½, 1 & 2 watt, in values 50 ohm. to 5 meg including many popular sizes, 3T, 15T, 20T, 25T, 50T, 100T, 250T, 500T, etc.

(Standard resistor color code supplied).

100 for **20/-**

(Plus 1/6 postage).

EW COILS AND INTERMEDIATE TRANS, STANDARD OR MINIATURE

By A LEADING MANUFACTURER

rmatune I.F. trans. 455K.C.	9/6
er. Permatune B.C. coils 455K.C.	7/6
F. Permatune B.C. coils 455 K.C.	7/6
c. Permatune B.C. coils 455K.C.	7/6
er. Permatune S.W. coils 16-50M.	6/6
F. Permatune S.W. coils 16-50M.	6/6
c. Permatune S.W. coils 16-50M.	6/6

NYLEX HOOK-UP WIRE AT HALF PRICE

Nylex hook-up wire 10/.010 in 100 yard coils, each coil consisting of five 20 yard lengths in 5 different colours.

10/- PER 100 YDS. Plus postage.

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640 KING STREET, ST. PETERS,
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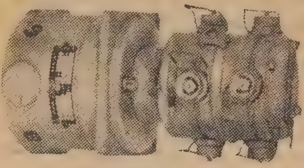
PHONE LA6087

479 PARRAMATTA ROAD,
LEICHHARDT, N.S.W.
PHONE LM3610

SMALL 24-VOLT AC/DC MOTORS



29/6
PLUS POSTAGE

AMERICAN ANTENNA SWITCHING MOTORS

Complete with 8 Pye-Type Coax Bases, R.P.M. 1750, Ball Bearing.

AMERICAN REDMOND BLOWER MOTORS

Ball-bearing, fully laminated, 6000 RPM, 1 amp spindle 1¼ x ¼. Complete with blower, new in carton.

45/- Plus Postage

39/6
PLUS POSTAG

Small 24v ball-bearing motor. Re versible, fully laminated, appro 1/15H.P.
Sizes 3¾" x 2½" with ¼" diamet shaft.

New Transformers Suitable For All Above Motors to Operate off 240 A.C. 30/- ea. plus postag

240 VOLT POWER TRANSFORMERS AND CHOKES

2000 x 2000v at 600ma.
1500 x 1500v at 700ma.
750 x 750v at 750ma.
240 to 110 at 8 amps.
240 to 110 at 8 amps. auto.
Above transformers.
£7/10/- each. F.O.R.

265 x 265 at 250ma.	£2/5/-
365 x 365 at 150ma.	£2/5/-
285 x 285 at 150ma. with 5v 2 amp and 6.3v 4 amp. fil. windings (standard)	£3/5/-
285 x 285 at 60ma. with 6.3v at 3 amp. fil.	£1/18/-

HIGH VOLTAGE TRANSFORMERS
Primary 240v. Sec. 4250v tapped a 3400 and 2500 .. .. £2/17/- F.O.I

CHOKES

600ma, £2/10/-; 150ma, £1/10/-; 100ma, 15/-, 60ma. 13/-. Freight extra on a transformers and chokes.

Heavy Duty Genemotor

Suitable for conversion to AC motor (approx. one sixth HP). Fully laminated. Can be used as 6 or 12 volt generator at 20 or 13 amps. £2/17/6 F.O.R.

NEW-AMERICAN TELEPHONE WIRE

Rubber insulation with stainless steel and copper conductors supplied on metal reels each containing half-mile of wire. £1/15/- per reel. Case lots, each containing six reels (three miles of wire)

£10 PER CASE F.O.R.

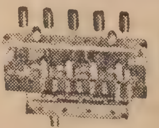
NEW C.R.O. TUBES

SUITABLE FOR TELEVISION EXPERIMENTS, OSCILLOSCOPES ETC.

V.C.R. 97, 6in. 47/
V.C.R. 138, 3in. 42/

Socket connections supplied.

PUSH-BUTTON SWITCHES



5-pole each 2 pair of contacts. Made in USA. Ideal for receivers, multi-meters, etc.
Price Each **12/6**
Packing and postage: NSW 9d., Interstate 1/6.

A.T.5-A.R.8 POWER SUPPLY

24 volt genemotors supply containing two genemotors, one giving 550 volt at 350 mills and the other 250 volt at 100 mills, also contains filter condensers, relays, fuse holders, etc.

£3/10/- F.O.R.

NEW TYPE RT34-AP513 TRANSCEIVER

450 MCS. Containing the following valves, 9-6AG5, 5-6J6, 2-2D21, 1-VR105. Circuit supplied.

Also contains midget 24V Genemotor.

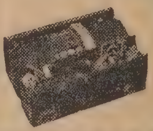
£15/-/-

NEW WESTON & FERRANT METERS

0-.5 amp. RF thermocouple	9
0-3 amp. RF thermocouple	9
0-4 amp. RF thermocouple	9
0-10mA DC	17
0-5 amp. DC	27
0-10 amp. DC	27
(All above are 2in flush mount.)	
0-10mA DC English Turner 3in. Round Flush mounting	20

Postage Extra.

SCR 522 GENEMOTORS



28 volt input D.C regulated and fi tered output fi tered D.C. 300 vol at .26 amps; 1 volts at .01 amp 14.5 volts at 5 Complete l shielded in met case, 12 x 8 x 5 inches.
Price, F.O.R. Each **30/**

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METROPOLITAN RADIO SUPPLIES

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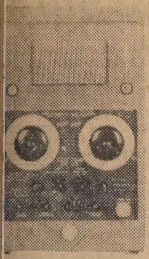
N.S.W.
PHONE LA6087

479 PARRAMATTA ROAD,
LEICHHARDT, N.S.W.
PHONE LM3610

A.R.8—COMMUNICATIONS—RECEIVERS

Converted for 240v. AC operation



Including power supply, 9in x 7in ovaltone speaker

A.P.8 receivers are manufactured by A.W.A. and have a continuous coverage from 140 K.C. to 20 M'CS in six switched bands. Set contains 13 valves as follows: 3-6A8G, 4-6U7G, 2-6V6G, 1-6B8G, 1-X5G, 1-6V4, and 1-6J7. Receiver, speaker and power supply are fitted in attractive and durable lastic-covered instrument case which makes this nit complete and portable. On/off switch and one control are also fitted.

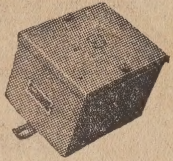
£34/17/6
F.O.R.

UNCONVERTED AR8

Supplied with valves (11) power supply lead and plug. **Air Tested. £23/17/[illegible]F.O.R.**

Supplied less valves and covers with power supply lead and plug. **£9/17/6 F.O.R.**

A.C. POWER-SUPPLY FOR AR8



240 volt A.C. power supply for use with any A.R.8 receiver. Supplied in brocaded - finish case, with standard A.R.8 power supply plug fitted. Ready to plug into your receiver. Output 250v at 125MA. with 12 and 6v filament windings.

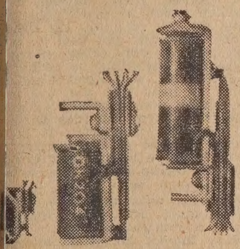
£7/17/6
F.O.R.

Circuit supplied free with all A.R.8 receivers

A.R.7 COMMUNICATIONS RECEIVER

hese popular receivers covering from 140 Kc to 25 Mcs in five bands feature single trength meter, crystal gate, noise limiter, two RF and two IF stages. upplied complete with nine valves· five sets coils· AC/Vib ower supply, speaker and mounting rack. AIR TESTED.

£47/10/-

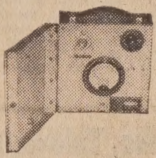


AMERICAN RELAYS

o. 1 Miniature relay 300 ohm il, S.P.D.T. contacts, 10/-
o. 2 Standard relay 250 x 0 ohm coil 4 pole S.T. 7/6
pole S.T. 6/6
o. 3 Standard relay, 15,000 m coil, 2 pole S.T. .. 12/6
All relays suitable for rewinding.

New dynamic mike inserts --	8/6
Bakelite fuse boxes -- -- --	4/6
Carbon mike transformers --	3/9
New throat mikes -- -- --	3/9
Shielded hook-up wire, per yd.	8
12v 400 watt prefocus globes	7/6
L.T. 53.3amp 6 or 12 v rect. --	45/-
Morse keys -- -- -- -- --	4/6
3 gang standard condenser --	18/6
3 gang midget condenser --	18/6
2 gang standard condenser --	15/-
2 gang midget condenser --	15/-
26-pin plug and socket -- -- --	5/-
5-pin plug and socket -- --	2/9
Fuse holders, bakelite, single hole mounting -- -- -- --	2/6
Lifeboat transmitters -- -- --	22/6
Teletron octal sockets, doz. --	3/6
9-pin loctal sockets, doz. --	5/-
6-pin wafer sockets, doz. --	3/-
5-pin ceramic sockets, ea. --	2/-
Acorn sockets, ceramic, ea. --	3/6

DIODE VOLTMETERS



Using 100 microamp meter with EA50 diode reads, 100 and 500 volts. Mounted in metal case. Ideal for rebuilding into sensitive multimeter. **£3/10/-**

TYPE 1133 TRANSCEIVER

Freq. range 90 to 130 m/cs, contains 17 6.3 volt valves.
F.O.R. £6/17/6

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METROPOLITAN RADIO SUPPLIES

540 KING STREET, ST. PETERS,
N.S.W.
PHONE LA6087

479 PARRAMATTA ROAD,
LEICHHARDT, N.S.W.
PHONE LM3610

ANSWERS TO CORRESPONDENTS

G.M.M. (Mosman, NSW) would like to enclose his loudspeaker and amplifier in a cabinet and would like to have details of vented enclosures.

A.: Data on vented enclosures for Goodman's speakers are available from Messrs. United Radio Distributors. A compact type of baffle, the RJ enclosure was described in our June, 1952, issue. We doubt, however, if this latter would do full justice to your equipment. It is not considered good practice to house the amplifier and turntable with the loudspeaker, as vibration from the cone may cause feedback. The more usual approach is to have the loudspeaker in a separate enclosure. A compact loudspeaker box giving ideal results has yet to be designed and we doubt if anything short of a 6 to 8 cu. ft. vented enclosure would produce satisfactory results with the loudspeaker your propose to use.

R.C. (Killarney, Q'ld.) says he has built the 2-valve set from the March, 1954, issue. It works well except for a ringing noise when the chassis or the valve is bumped.

A.: We are glad to note that the set is working well in other respects. The gauge of wire on the reaction winding is not very critical and the use of 38 gauge instead of 40 was quite in order. The ringing effect you note is known as "microphony" and is generally caused by the vibration of loose electrodes within one of the valves. Since it appears that the 3V4 is at fault in your case, it would suggest a very poor valve indeed. The IT4 would be the one most likely to show such a fault in this circuit, because its output is amplified by the second stage.

R.S. (West Ryde, NSW) has tried our suggestions about HT supplies for the Improved Intercom Amplifier and obtained good results. He would like to know if it is possible to use a microphone with this amplifier.

A.: It would be possible to use a separate microphone with the Intercom Amplifier, but we doubt if the results would justify it. As the amplifier has been designed for low-level speech only, its power output is severely limited and hardly adequate for music except at very low volume. If you do want to use a separate microphone, it would have to be switched into the first grid circuit.

J.C.W. (Geraldton, WA) sends in some questions for our Answer Tom page.

A.: Thank you for your letter J.C.W. We have put it in our Answer Tom file for possible later use in that column.

R.F. (Morningside, Queensland) has been trying to connect a carbon microphone and a pickup to his radio set. Thus far he has had no success.

A.: You have the right idea about using a transformer and battery with the carbon microphone and we are not certain where you are going wrong. However, it may be that you are trying to connect both to the set simultaneously. We suggest that you couple up the pickup and get it working first and make sure that everything is in order. You should then be able to get some results merely by disconnecting the pickup leads from the set and replacing them with those from the secondary of the microphone transformer. This transformer should have a large step-up ratio, otherwise it may not deliver enough signal to the set to produce worthwhile results. On the other hand, too much gain could lead to howling troubles unless the microphone and speaker are located in different rooms.

J.M.H. (Narrabri, NSW) has a couple of problems which he would like explained.

A.: High peak voltage can easily build up across the capacitors in a power supply in the absence of any load across the output. When the supply is switched on, a circulating current flows through the filter system, because the capacitors themselves have a definite impedance, at th 100 cps ripple frequency. The flow of current is rectified by the valve and results in a charge being built up across the filter capacitors. In the absence of any bleed current they are charged to practically the full peak value of the input. The presence of a load causes them to discharge more or less between input cycles so that the average voltage is lower. Regarding your second inquiry the 1.5 volts normally employed in a multimeter are not sufficient to damage electrolytics when applied across them in reverse. We do not encourage readers to visit our office for purposes of technical discussion, testing sets or even looking over the laboratory. This is not prompted by lack of courtesy but
by the very severe embarrassment
follows when large numbers of rea
have the same idea. It taxes our
sources merely to keep up with rou
requests for circuit reprints and techn
queries through the mail.

J.W.T. (Sydney) has a commercial
ceiver in which a resistor burned out
wants to know what its value would

A.: We do not keep records in our
fice of commercial sets and cannot
certain of the exact figure. Howe
from your diagram it appears to b
back-bias resistor and we tip that
value would be either 350 or 400 oh
In practice either one could prob
be used without danger or ill-effe

M.M. (Ballarat, Victoria) is building
All Wave Battery Two and wants
know where he could obtain pla
coil formers.

A.: Such formers have been ma
factured for many years by RCS Ra
Pty. Ltd., who advertise regularly in
magazine. If you cannot obtain supp
from your local dealers we suggest
write direct to RCS at 651 Forest
Bexley, NSW.

J.D. (Castlemaine, Victoria) points
that he has noticed two or three instan
of a discrepancy in the volume and se
numbers between cover and title p

A.: We must plead guilty on this
casion as something did go off the r
However, you will find that the co
reference is correct, since it is so
thing we always check carefully.
have no information about the expos
times that you mention in your let
However, some other reader may
able to supply you with a circuit. (
would like details of a photo timer
works from a single B battery and flas
a red light to indicate various expos
intervals.)

E.J.W. (Dubbo, NSW) advises us
some advice which we previously offe
regarding the use of a top cut filter
been very beneficial and that he is c
sidering putting our other suggesti
into practice regarding a Playma
Seven and a No. 6 Control Unit.

A: Glad to hear that you are on
way to solving your trouble, E.J.W.,
we hope the rest of the idea works
as well as the first part. It is q
likely that the use of the heavier tu
table will improve results and it is c
tainly worth trying in the circumstan

N.P. (Wembley, WA) writes to tell
of his success with the D/W Stand
Five of August, 1954, which functio
as soon as it was switched on.

A: Many thanks for your letter, N
and we are glad to learn that the
is going so well and that the data
garding the tuning indicator was of va
to you. Thanks also for the seas
greetings which we reciprocate, e
though they may be a little into
new year by the time you read this

A.B. (Toorak, Vic.) writes to us to s
his best wishes for Christmas and
New Year and another year's subsc
tion. He also has a little message
the WIA.

A: Thank you for the good wishes
the subscription, A.B. Regarding y
query concerning the WIA, we sug
that you contact the local president,
J. Corbin. At the moment we have
plans for the type of set you ment
but we may well describe such a
ceiver at a later date.

K.R.M. (Prospect, S. Aust.) writes to
about some of his experiences w
working in the school lab.

A: Milliampmeters are very delicate
struments K.R.M., and it does not
much of an overload to bend the poi
to a shape shown in your illustration
worse). This is what usually happ
The overload twists the moving
with such speed that the pointer,
to its inertia cannot follow immediat
It therefore bends backwards at
top. When it follows the coil a frac
of a second afterwards, it hits the
and bends in the opposite direction.
as for the HT and filament wires get
mixed up—well, now you know,
valves don't like being overloaded, eit

The Radio, Television and Hobbies Query Service

All queries concerning our designs, to which a POSTAL REPLY is required must be accompanied by a postal note or stamps to the value of TWO SHILLINGS.

For the same fee, we will give advice by mail on radio matters, provided the information can be drawn from general knowledge. UNDER NO CIRCUMSTANCES, however, can we undertake to answer problems involving special research, modification to commercial equipment or the preparation of special circuits.

Whatever the subject matter, we must work on the principle that a letter is too involved if the reply takes more than 10 minutes of our time.

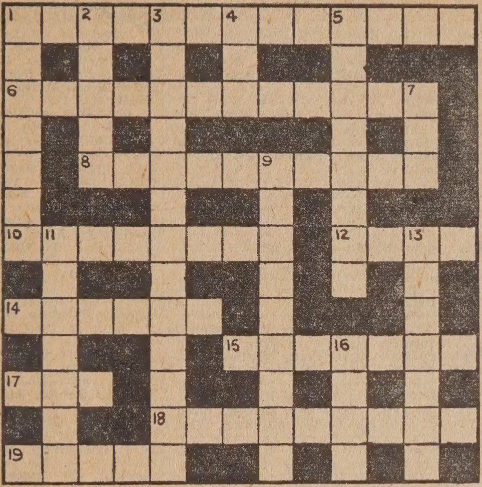
Queries not accompanied by the necessary fee will be answered FREE in the columns of the magazine and presented in such a way as to be of interest to other readers.

To those requiring only circuit reprints, &c., we will supply for TWO SHILLINGS diagrams and parts lists from our files covering up to three constructional projects. Scale blueprints showing the position of all holes and cutouts in standard chassis can be supplied for 5/-. These are available for nearly all our designs but please note they do NOT show wiring details.

Address your letters to The Technical Editor, RADIO, TELEVISION and HOBBIES, Box 2728C, GPO, Sydney.

Note that we do not deal in radio components. Price quotations and details of merchandise must be obtained direct from our advertisers.

HE R. & H. CROSSWORD No. 12



ACROSS

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(2 words)
Jsed on con-
rol shafts.
(pl)

DOWN

Unit of
magneto-
motive force.
2. For inter-
connecting
units of
equipment.
(pl)
3. Basic or
fundamental
units. (2
words)
4. Switch
position.
5. Point of con-
nection.
7. Unit of
energy.
9. Heat treat-
ment process.
11. TV camera
tube.
13. Part of radio
transmission.
16. Raised
platform.

Solution and further crossword next month

). **(Kings Cross, Sydney)** sends in ber of questions and suggests that ould be answered in our "Answer page.

Many thanks for your letter and, suggest, we will deal with your ons at the first opportunity under s Your Answer, Tom".

(Fernhill, NSW) writes to us in to our letter about turntable

'he covers have duly been posted , R.B. We hope that there will nty of things in future issues of d H. to interest you. We wish very success with your Playmaster

K. (Ormond, Vic.) has a number blems concerning tuners and voice stems.

'rom your description it would seem certain that the IF channel of tuner is unstable when in the nor-osition. It is probably quite stable broad position, due to the much-ed gain. We can only suggest that heck this possibility and take all ormal steps to cure it. It is often to deliberately reduce the gain rarily (by reducing the screen vol-or increasing the bias voltage) or g one of the IF windings with a r until the set is stable. Under conditions it is much easier to circuit and layout faults which ontributing to the condition. At ame time you could easily have a ive IF. See if adding a small con- across the affected winding will it to a peak.

impedance presented by the two ers is rather a complex value and uld be impossible to give a single which would be completely ac-. Assuming that both speakers had cal characteristics and were sup- with all frequencies equally they simply be regarded as being in el and the fact that both were con- to the secondary would cause a of half the nominal value to be nted by the primary winding. How- if each speaker was only operative over a portion of the spectrum and presented a high impedance (by reason of a crossover network) over the other portion, the condition would be more like that of a single speaker. Considering that the impedance of any speaker will vary over a very wide range and that a modern amplifier with adequate feedback can take care of such variations, there is little point in worrying unduly over the matter. This subject was discussed in some detail in a recent argument article. Assuming that the top cut filter is included only in the high frequency speaker circuit it would have to be designed for a 30-ohm circuit in order to give correct results. Many thanks for your comments on the divider networks article of May, 1949, and we will keep your ideas in mind. However, we feel that most problems could be solved by reference to this article which contains a lot of valuable data.

Last Month's Solution

E	L	E	C	T	R	O	M	A	L	U	X	
L		A		R				W			R	
A	E	R	I	A	L	P	O	L	E		A	
S		T		N		A					Y	
T		H	I	S	S	I	N	G		U	S	A
A		W		C	O	R	E			N		B
N	O	I	S	E	S		G	R	I	D		S
C		R		I			A			A	R	C
E		E		V	O	L	T	S		M		I
	W			E			R		A	P	E	S
G	E	N	E	R	A	T	O	R		E		S
	A		M		W		N			D		A
C	R	Y	S	T	A	L	S	E	T			

THE KIPP ELECTRONIC RELAY

(Continued from Page 73)

struction is used to keep stray capacities to a minimum.

The figure (5) shows the relationship between the input and output potentials of the circuit. For the second application an indicator is connected into the circuit so as to show if one of the triodes is conducting or not; a binary counting unit is thereby formed. To complete a counter, a number of such units are connected in series in the same manner as for the frequency divider.

In order to count in the decimal system, that is from 0 to 9, feedback has to be arranged over certain of the stages and a meter used to indicate the sum of the anode currents of individual triodes whose various combinations of OFF and ON form 10 separate steps so indicating all the digits from 0 to 9.

Here's Your Answer Tom

(Continued from page 59)

have two front ends, each consisting of the usual RF, converter and IF stages, one for AM and one for FM.

The AM section has a conventional diode detector to separate the carrier from the audio signal, while the FM section employs a so-called frequency discriminator for the same purpose. The selected section feeds a common audio output stage and speaker.

On the Continent, local broadcasting stations mostly use FM on the VHF bands, because the "medium wave" broadcast band is already overcrowded by the large number of national stations operating there.

For local programs FM is generally considered superior to AM. This is due to the fact that it is less prone to electrical interference and allows improved reproduction in a well designed receiver.

Contacts for Electronic Flash

(Continued from Page 112)

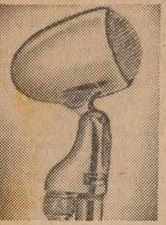
appear that this latter connection is unreliable a separate earth lead should be provided.

The only disadvantage of this system is that the firing circuit will be closed both when the shutter is loaded and when it is fired. This may prove inconvenient if, for any reason, the flash unit is charged before the shutter is loaded since it will be necessary to waste a flash to load the shutter. This is even more important if expendable bulbs are being used.

If this characteristic is likely to prove troublesome it would be comparatively easy to fit a simple press type switch of some kind which can be held down to open the firing circuit while the shutter is loaded. It would probably be most conveniently accommodated on the flash gun.

AWA RONETTE

MICROPHONES & ACCESSORIES



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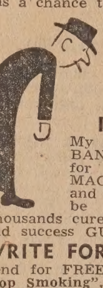

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MOTOR SPARES
PRICE CORRECTION

Due to a technical error on Page 88 in March Radio & Hobbies, the price of the cathode ray indicator in Motor Spares advertisement was shown as £5/10/-. This should have read £15/10/-.

Any inconvenience caused by this error is sincerely regretted.

Every week a long

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POCKET BOOK Storyteller Weekly 1/-

WANTED TO BUY SELL OR EXCHANGE

Cost of Classified advertisements in this section is 2/- per line, approximately five words to a line. Closing date for May issue of Radio, Television and Hobbies is Wednesday, April 12.

FOR SALE: Radio and Hobbies back numbers, perfect condition. From July, 1953, to December, 1954, what offers. **D. Dennis, Coolangatta, Queensalnd.**

FOR SALE: All back issues R & H. 4/- per copy, incl. post. Write for copy, circuit, article, &c., required. New Supplies just to hand. **T. Weir, 73 Gibson Av., Padstow, NSW. UY8056.** All copies good condition.

FOR SALE: 150 copies of R & H. Best offer. **W. Stuart, 15 Orchard Rd., Cardiff.**

SELL: New Resistors. Well known make. 200 ohm to 10 M in ¼, ½ and 1 W. Assortment of 100 handy values for 10/-, post free in Aust. **P. Lavers, 261 Barkly St., St. Kilda, Vic.**

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SELL: Modulated oscillator, Zenith Radio product. range 95 Kc to 30 Mc, £12/10/-. Also R & H '46 to '54 25/- per year, post free. **H. Hobcroft, Renmark, SA.**

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